ENGINEERING NEWS

Tribune Building, New York City.
GEO. H. FROST, PROPRIETOR.

SATURDAY, FEBRUARY 12, 1881.

ANOTHER million is to be appropriated for the new Capitol at Albany, making a total of $12,900,000.

THERE will be a convention of the surveyors of N. E. Missouri, held at Moberly, Mo., on the 15th inst.

LAST year the sales of the Reading Iron-works amounted to $2,800,000, an increase of more than a million dollars over the sales of the year previous.

THE Rochester *Union* shows that an original investment of $10,000 in Western Union telegraph stock is now held at $481,700, and that the cash dividends have amounted to as much more.

HISTORY OF AMERICAN WATER-WORKS. — We are indebted to A. H. Martin, Engineer and Superintendent of Water-works, Fall River, Mass., for full reports of the Watuppa Water Board, to end of year 1880, for which we are much obliged.

CIRCULARS requesting a meeting for the formation of an association, have been sent to the surveyors of Indiana, and returns therefrom are so encouraging that a meeting will probably be held during the last week of the month. We are glad to see the growth of this movement among land surveyors; it is bound to be productive of great good to their profession.

THE great international race of the near future will be between the different electric companies. The Gramme system is making great headway in Europe, various allied societies are forming in Spain and other countries, and if a company is to get fifty times its capital in eight years, there is certainly every reason that the electric trade should flourish. In the meantime the Brush Company is active, and only the man on whom the greatest hopes were placed has so far kept back from public "illumination."

LIFE in large cities is becoming, as it were, more complicated than ever. Telegraph wires darken the light above us, and become a source of danger in a storm. But the streets underneath, and the houses we live in, are also threaded with pipes and drains to such an extent that any work in them is greatly impeded. An English paper has drawn up the following list of these *impedimenta:* Speaking and bell-pipes, gas, drain, soil, waste, warning, cold water, hot water, steam, flow, return-coil, expansion, high-pressure, air, and flue pipes with their multifarious auxiliaries in the form of pans, sinks, traps, syphons, cocks, cisterns, filters, tanks, valves, pumps, etc. All these appliances have, however, gone past the theoretical knowledge of the ordinary plumber, and thus the sanitary engineer has come forth to meet the "situation," and to try and prevent typhoid fever. The sanitary engineer is now an acknowledged specialist of the profession.

THE WASTE OF WATER.

There has been an unusual amount of newspaper engineering done for a few days past concerning the scant supply of Croton in this city; the Water Department officials have individually been interviewed by reporters from each of the daily papers; editorials berating the unfortunate dispensers of the precious fluid have not been scarce; several "medical men" have added to the terrors of the situation by their predictions, and, taken all in all, Chief Engineer Campbell and his assistants have not found their official beds the "softest things on earth" to repose upon for a week past. The amount of rubbish and nonsense, pure and unadulterated, that has been published, especially in the *World*, is quite marvelous to behold.

In fact, there is an ample supply of water for the *necessities* of New York, but on account of the extended drouth of last season, as explained by Chief Engineer Campbell, the supply for *waste* is not quite sufficient. And it never will be, since the capacity for waste of the average American citizen, whether native or foreign born, is past all calculation. In this favored country of boundless resources, to waste, rather than to economize, is inborn to the native, whose habits are very soon copied by the new comers from less favored regions.

The daily supply of Croton at present is 65,000,000 gallons per day, with a storage last week of about 600,000,000 gallons; although in the middle of winter, the consumption on Friday and Saturday of last week was 104,000,000 gallons per day, or about 70 gallons per capita per diem. There has no doubt been some inconvenience in portions of the city, and there will continue to be so long as the incessant waste of water is continued, and it is difficult to see how the Water Department can do more than they have to prevent it. Of all persons in the city they are the best qualified to regulate the supply, and it is satisfactory to know that their professional standing in the community is not at the mercy of the repertorial engineers of the daily press.

The advantages and disadvantages of metering the supply of water to all consumers, the same as gas is measured, has been very extensively discussed, and the question is still an open one. Experience in Liverpool, England, has shown conclusively how waste can be checked, and from an insufficient supply an abundance be obtained. Statistics have proved the efficiency of meter measurement in the case of large establishments, and we this week publish elsewhere the best argument on the subject of its more universal adoption that we have yet seen. The tabulated results of the use of meters in large and small numbers, as shown by the statistics of Providence and Milwaukee, cannot fail to interest every person interested in the subject of a public water supply and how to make it most efficient. Providence, R. I., is a city where the civil engineering profession may be said to be in the ascendency, and we feel safe in saying that in no city in the country are more comfort and convenience obtained for the same money than there. The highest salaried official is the city engineer, and the city government has learned by experience that his recommendations are in the direct line of economy, health, and the general well-being of all the citizens.

Milwaukee, Chicago and Cleveland, having the great lakes for a reservoir, feel that they can waste without stint; the consequence is shown in the increased expense of pumping, an item that is scarcely ever thought of, which, as the population increases, also increases, but in larger ratio as new machinery is called for. Whether or not the limit of waste will be determined by water-works authorities, and there held by mechanical devices authorized by municipal laws, is now a question that is yearly assuming increased importance, and which, no doubt, will yet be solved in the best interests of the people.

PERSONAL.

Chief Engineer E. H. Wills, with a corps of assistants, left Galveston, Tex., on the 5th, to survey the route of the Kansas & Gulf Shore Line railroad from Tyler to Homer.

J. H. Barlow, Esq., son of Mr. W. H. Barlow, past president of the Institution of Civil Engineers and chief engineer of the new Tay bridge has returned from several months residence in Virginia, and is now at 21 Rowley St., Rochester, N. Y.

At the last regular meeting of the board of mayor and aldermen, of the city of Fall River, Mass., Philip D. Borden Jr., was nominated by his honor, the mayor, and confirmed by the aldermen, as city engineer for one year from March 1, 1881.

Sandford Horton, C. E., has been appointed locating engineer of a division on the Mexican National Railroad, where he goes at once. Headquarters unknown at present. Last address, 2d inst., Kansas City, Mo.

Mr. J. J. McVean has been appointed chief engineer of the D., L. & N. R. R., vice General M. T. Thomas, resigned on account of failing health. Mr. McVean held the position of assistant engineer for three years previous to his recent appointment.

Col. Robert J. Lawrence, a well-known civil engineer of Pittsburgh, died in Texas a few days since. The remains reached that city on the 8th, and the funeral took place from the residence of his mother, No. 106 James street, Allegheny, the same day.

The October bulletin of the "Institut Géographique International," of Berne, Switzerland, contains a splendid map of the South Pole regions, colored and printed on cloth. It shows the routes taken by the twelve prominent navigators, from Cook in 1772, to Nares, in 1874, in their efforts to penetrate the icy seas of the Southern hemisphere.

Mr. Charles A. Ashburner, a member of the American Institute of Mining Engineers, long connected with the Pennsylvania Geological Survey and a most active working member of the Engineers' Club, of Philadelphia, was married on the 27th ultimo, at Pottsville, Pa., to Miss Roberta John, daughter of the late Dr. Henry John, of Columbia, Pa.

Frank P. Davis, a graduate of the Michigan University of the class of 1876, for the past two years engaged under Col. Thos. L. Casey, U. S. Engineers, on the construction of the new building for State, War and Navy Departments in Washington, D. C., has been appointed to the charge of a locating party on a new railway survey in Colorado. Mr. Davis is to report in Salt Lake City immediately.

Mr. C. Buxton has been appointed chief engineer for the Ohio Central Railroad Company, with headquarters at Toledo, vice S. M. Seymour resigned. Mr. Buxton will assume control of roadway, bridges and buildings, and heads of those departments will report to and receive instructions from him. By order of G. G. Hadley general manager.

The Brazilian Government does not seem to be quite exempt from the "Know-Nothing" prejudice. The chief engineer of the Bahia Railway extension has just been dismissed because he is of Hungarian birth. The gentleman in question is a naturalized Brazilian, was specially recommended from the Institute of Vienna, and his services on various lines in Brazil earned for him decorations from the government.

Mr. Edward Prince, of Quincy, Ill., consulting engineer of the Sny Island levee, has been spending the week in this city; he goes to Philadelphia and Washington early next week. Mr. Prince is especially well known to the engineering world as the former superintendent and engineer of the Quincy water-works, and as having accumulated, after large expenditure of time and money, the most complete sets of reports of United States water-works now in existence. A large portion of these reports have already been compiled by Mr. Prince, who has very generously placed his

manuscript at our disposal for use in Mr. Croes' forthcoming papers on American water-works.

Gen. M. T. Thomas, until recently chief engineer of the Detroit, Lansing & Northern Railroad, has been obliged by failing health to seek a more favorable climate. Gen. Thomas was connected with the above road about eight years, and as an expression of their esteem for him, some 104 resident employés at Detroit, on Saturday evening, the 29th ult., presented to the General a purse containing $300 in cash, together with a paper expressing the hearty good will of the donors, each of whom had signed it in his own handwriting. An elegant water set of the value of $55 was also presented at the same time to Mrs. Thomas.

Prof. A. J. Du Bois, of Yale Scientific School, will deliver a lecture on "The Story of a Lighthouse," on Friday evening, the 18th inst., in Association Hall, 23d street, corner of 4th avenue, New York, commencing at 8 o'clock. The lecture is one of a popular course given by the Young Men's Christian Association, of this city. Admission fifty cents. The lecture is an account, told in the most charming way, of the labors of Winstanley, Rudyerd and Smeaton in rearing the Eddystone lighthouse, and appeals directly to the profession, which is the subject of the learned Professor's most enthusiastic praises.

Mr. C. C. Waite, superintendent of the C. & M. V. Div. of the P. C. & St. L. Ry., has just been appointed superintendent of the Little Miami Div. of the same road, vice Jas. D. Ellison, resigned. This is one of the most important divisions of the line, comprising the road from Columbus to Cincinnati, O., and also the divisions from Xenia, Springfield, Dayton & Richmond. Mr. Waite is a graduate of the Rensselaer Polytechnic Institute and a member of the American Society of Civil Engineers. A recent inspection of his division showed it to be in perfect condition, while his report for the past year exhibits a maximum of economy in expenses, and it is a pleasing fact to record that during the fifteen years tenure of office of Mr. Waite there has not been a passenger injured on his division. Mr. Waite, like his father, the chief justice, is an "Ohio man."

The organization of the Road Department of the Baltimore & Ohio Railroad, to take effect Feb. 1, 1881, is as follows:

Mr. Bolling will have charge of the records, maps and surveys appertaining to real estate, right of way, taxes, corporations, etc., on main line and branches, and such other engineering duties as may be assigned to him from time to time. Office, Camden Station.

Mr. H. B. Baylor has been appointed assistant master of road, First Division. Mr. Baylor will have charge of the maintenance of track of the First Division, embracing terminal stations, Baltimore, and main line and branches east of mile-post 80 (Harper's Ferry). Headquarters, Camden station.

Mr. A. Hunter Johnson has been appointed assistant master of road, Second Division. Mr. Johnson will have charge of the maintenance of track of the Second Division, from mile-post 80 to mile-post 240. Headquarters, Cumberland.

Mr. B. T. Fendall has been appointed assistant master of road, Third Division. Mr. Fendall will have charge of the maintenance of track of the Third Division, from mile-post 240 to mile-post 280, and the Parkersburg Branch. Headquarters, Grafton.

Mr. J. A. Hunter has been appointed assistant master of road, Fourth Division. Mr. Hunter will have charge of the maintenance of track of the Fourth Division, from mile-post 280, to Wheeling, and the Wheeling, Pittsburgh & Baltimore Division. Headquarters, Grafton.

Mr. Oliver Kemp has been appointed supervisor of bridges, main line and branches east of Cumberland, and of buildings and water stations between Cumberland and Harper's Ferry, and on the Valley Branch. Headquarters, Harper's Ferry.

Mr. Arthur Sinsel has been appointed supervisor of bridges, buildings and water stations west of Cumberland, main line and branches. Headquarters, Grafton,

Mr. C. McLean has been appointed supervisor of buildings and water stations east of Harper's Ferry. Headquarters, Baltimore.

Mr. Kemp, Mr. Sinsel, and Mr. McLean and the supervisors of Valley Branch will report directly to the master of road; all other supervisors of subdivisions will report directly to the assistant master of road of their division.

"SURVEYING, LAYING-OUT AND MONUMENTING" THE TWENTY-THIRD AND TWENTY-FOURTH WARDS AND PART OF THE TWELFTH WARD OF NEW YORK CITY.

I.

These surveys were commenced in about the year 1868, under Commissioners of the town of Morrisania.

For the Morrisania survey, the line of Avenue A was made a base, and was produced northerly, forming Willis avenue in Morrisania.

All the surveys were based upon this line as a meridian, and co-ordinates were calculated for all stations and street monument points without any regard to the magnetic meridian.

This work was all performed by contract, and was generally well performed, though some serious errors have been detected in the positions of street monuments.

In this work an effort was made to have each block correct with itself, and the principal inaccuracies have been found in connecting blocks divided by old roads that were not of uniform width. At about the time of the completion of the Morrisania survey, an act was passed by the Legislature authorizing similar work in the towns of West Farms, Westchester, Eastchester and Yonkers, south of the then south line of the village of Yonkers by the Commissioners of the Department of Public Parks.

By a subsequent act Eastchester and Westchester were taken from the control of the Park Commissioners.

For this survey contracts were given to surveyors familiar with the locality, a portion of West Farms and of Yonkers (then known as Kingsbridge) being surveyed by Department engineers, but all being under the supervision of the Civil and Topographical Engineer of the Department of Public Parks, which office was then filled by Wm. H. Grant.

In these surveys by contractors the line connecting monuments of Tenth avenue at 203d street and 225th street was given as the base, and the monument at 225th street as the initial point of measurement.

To insure accuracy a set of standard rods were made by an instrument maker supposed to be reliable, and the contractors were required to mark the rods with which they made the surveys by this standard. The rods used in surveying were 25 feet in length, a pair being used together so as to measure 50 feet at a time. They were made of wood with the edges kept straight by means of an arched truss, and struts at frequent intervals. When used, these rods were supported at the ends by standards made of gas pipe with movable arms fastened by thumb-screws, so that the rods could be always level, a bubble being placed in one end of each rod for that purpose. The limit of allowable error prescribed for this work was very small, being five seconds for each angle measured, and fifteen hundredths of a foot for each 1,000 feet of traverse when tested by calculation.

More difficulty was found in making the working-rods of uniform length than in making a circuit measured by either set close with the required accuracy, as no two surveyors marked their rods of precisely the same length, though all used the same standard.

For doing such close angular work, not only is great care and skill required, but also repeated readings of each angle and almost perfect instruments, and of course an entire ignoring of the magnetic needle. In these surveys Stackpole instruments were used, and as none of these were graduated to read a smaller angle than one of ten seconds at a single reading (some of the best being twenty second instruments), the rule in the Department has been to take six readings of each angle.

The six readings are not independent of each other, but after noting the first reading, the measurement is continued until the last reading of the vernier added to the number of complete circles that may have been turned shall be six times the size of the angle.

If one-sixth of this aggregate differs from the first reading as much as twenty seconds, the vernier is placed at zero and the work is repeated for one reading, and, if found necessary, for the six; but this is very rarely required with an instrument that can be used at all in the work. Accurately turned, heavy, brass plumb-bobs, with the line passed through the cap and fastened to the ball, have been found indispensable; and with these, and with the measuring chains, experience has been the same as with the transits: although different makers have furnished those that have been used, only one firm's make has been found reliable. That the necessity may be appreciated of nearly perfect instruments and great care being used in this work it should be remembered that an error of the one-hundredth part of a foot in placing the plumb-bob, would, in a line one hundred feet in length, cause an error of twenty seconds in the measurement of the angle, which is more than four times the error permitted in each angle when detected by calculation after closing a circuit.

An almost indispensable peculiarity of the transit instruments used for this work is the telescope being made reversible in the wyes instead of revolving.

Advantages of this arrangement consist: in permitting the shortening of the standards, causing greater stability; the lengthening of the telescope, causing, as in a rifle barrel, greater lineal accuracy; and, what is of most importance, the allowing the telescope to be always used with the same side up, causing an entire elimination of the errors due to a want of adjustment in the line of collimation.

An invention of one of the contracting surveyors, combined with a tension and temperature adjustment, and manufactured by the firm of instrument makers previously mentioned, rendered unnecessary the cumbrous wooden truss-rods previously described.

This invention consists in a chain or tape, made of flattened wire (similar to that formerly used for ladies' fine hoop-skirts) with flat pieces of brass soldered upon it to be notched for the plumb line at the rear end and at twenty, twenty-five and thirty feet distant. The handle at the forward end is attached to a spring balance and thermometer and connected with the chain by a snap hook, so as to be readily detached. A screw with threads the distance apart that a wire fifty feet in length will expand by an increase of ten degrees in temperature, and marked to correspond with the marking of the thermometer, forms a part of the chain, so as to adjust its length by the temperature. The case of the balance is grooved for the plumb-line and conceals a level-bubble attached to the handle, which becomes visible when a tension of eight

pounds is applied. The short distances are measured with steel ribbon pocket-tapes.

ENGINEERING GOSSIP.

THE NORTHWEST.

Extensive work for deepening and otherwise improving the harbors and water courses of the northwest are in progress, under charge of Major Charles J. Allen, U. S. Engineer. The harbor of Duluth has now a depth of 16 feet, that of Grand Marais, 13 feet. The Red River has been dredged and cleared of snags and bowlders, between Fort Abercrombie and Caledonia. The commercial importance of this improvement is shown in the fact that 17 bushels of wheat are now transported as against 1 in 1878. The St. Croix, the Chippewa and the Minnesota rivers have all been more or less regulated, but little has been done on the last named since 1878. Some work is at present being done on the Mississippi, above Aiken, and navigation has been greatly improved. Surveys for reservoirs on the sources of the Mississippi, St. Croix, Chippewa and Wisconsin rivers have received attention at the hands of the engineers since 1870. If it shall be proved beyond doubt that the entire system in Minnesota and Wisconsin be feasible and desirable, the State of Minnesota (and the city of St. Paul), through its steamboat interests, will be benefited by the increased volume of water from the proposed collective reservoirs, to add to the low-water discharge of the Mississippi throughout the river front of the State. Captain Mackenzie has charge of important works at Rock Island, for the improvement of the low-water channel of the Mississippi between St. Paul and the Illinois River.

INDIANAPOLIS WATER.

If the people of Indianapolis are advocates of prohibition, the credit for it can hardly be laid to the quality of the water of that city. The Board of Health in its reports gives some startling information as to what people may gulp down from an Indianapolis hydrant. The following extract "speaks for itself:"

"We found the water immediately over the filter literally full of animal matter, in the shape of pieces of the intestines and other organs of hogs, and masses of hogs' hair, and other products that only wanted a higher temperature to become extremely offensive. The Board of Health have in their possession certificates showing that there was taken from a hydrant in a store on Washington street a mass of hog hair with the epidermis attached, proving conclusively that it was in the same condition as when taken from the hog. We have another certificate from one of our well known business men that the water passing through the hydrant in his office was very filthy and offensive, and was mixed with blood on several occasions. We have a sample of water from the hydrant and a certificate from one of our best-known physicians, which shows that the water furnished by the hydrant in his house was utterly unfit for any domestic or family use. We also have a certificate from the employes of one of our most extensive hotels, that from the pipes supplying a part of the hotel with water from the water-works there was taken a piece of intestine (gut) eight inches long, and weighing one-half a pound. There was no possible means by which this could have reached there except through the pipes from the water-works."

The Board of Health is to give the matter another discussion.

BOSTON MYSTIC WATER SMELLS.

A gentleman writing to the Boston *Herald* gives an account of what the inhabitants of Medford and other places along the Mystic Valley have to suffer from sewage slime. Boston has done something to preserve the purity of the water of Mystic Lake, but the evil is too deep seated to be cared for by a single sewer. The lake has an extended water shed, which is the seat of large communities, some of them engaged in a class of industries in which water is used in large quantities, and in its use necessarily subjected to the worst kind of pollution. This waste, when once set loose, gravitates toward the lake, and must finally reach it.

CHICAGO AND COLUMBUS DRAINAGE.

A great deal of discussion is going on in Chicago with regard to the drainage of the canal and the Illinois River into the Desplaines River. A deepening of the canal has been suggested, and in this connection the opinion of Engineer C. E. Carter, of Austin, Minn., under whose supervision the deep cut was made may be quoted:

"It is my opinion that the canal could be widened so as to make it 150 feet wide to Lockport, with the banks substantially protected by a vertical wall, for less than one-half the cost of the main sewer recommended by the Citizens' Association Committee. Just think of excavating this 'main sewer' to a depth of over forty feet through the rock sections below Summit! It would cost five times as much to execute work in the sewer as it would in widening the present canal. * * If I had one of the original canal field-books, I could make a close estimate on the amount of excavation required for a canal 150 feet wide. The only uncertain quantity there would be about it would be the amount of material thrown out on the towpath side by former excavations, but that could be closely approximated."

City Engineer John Graham has sent in his report to the City Council of Columbus (O.) on the West Side drainage of that city. Owing to the low surface of the portion of the city lying west of the Scioto river there is great difficulty in overcoming the gravitation. The use of steam is too costly. Mr. Graham says:

"I extended my levels down the river to determine whether an outlet could not be found within a reasonable distance which would be far enough under high water line of the river opposite the territory to be drained as to be safe from back water through the line of the sewer in times of extreme freshets. I found that such a point could be had about one-third of a mile below the Harrisburg bridge. Starting from this point, with an ascending grade of only two inches to the hundred feet, by the time we reach the territory to be drained the upper arch of the sewer would be very nearly on a level with the surface, which would hardly afford surface drainage; the depth of the sewer would not admit of drainage of cellars or vaults."

He proposes a plan for a valve, and estimates the cost of sewerage at a total of $9,763.

CANALS.

The project of a canal or harbor channel to connect the Bayou St. John with the Mississippi River is being agitated at New Orleans. The City Council are to consider the matter, and Congress is to be memorialized for government aid. The canal would be 350 feet wide, 25 feet deep, and should be excavated, leaving the Mississippi above Carrollton and entering the river again below the Barracks. Only a thorough survey can show whether the plan be feasible; if so, vessels could pass from the River to Lake Pontchartrain in one hour's time, with a distance of six miles, instead of having, as at present, to pass around by the mouth of the river—a distance of 250 miles. The excessive depth of water at the wharfs of New Orleans, some 175 feet, is also an inconvenience which it is sought to remedy.

NEW ENGINEERING BONANZA.

An undertaking is contemplated in California, which, if successful, ought to prove one of the most lucrative works in which engineering skill is requisite. It is proposed to work out thirteen miles of the bed of the Feather River, by a tunnel of sufficient capacity to drain the river bed. The river makes a large bend at Whiskey Bar; it is in the shape of a horseshoe, and thirteen miles in length. It is proposed to construct an eocene tunnel to drain the river. It will be 11,600 feet in length, and a little larger than the ordinary railway tunnel, with a fall of 52 ft. 9 in. to the mile and a discharging capacity of 6,820 miner's inches of water per second. Judging from what has been taken out, it is estimated that thirteen miles of the river at Big Bend contain about $150,000,000! About one million must be expended however, before any great results can be obtained.

SOMETHING FOR MINERS.

The geological survey of the Rocky Mountains is being actively pursued under the direction of Mr. Clarence King, who is publishing very interesting monographs of the results of the labors of his staff.

At present the survey labors in the West are distributed over three divisions. The Division of the Pacific, including all the States and Territories upon the West coast, the Division of the Basin and that of the Rocky Mountains, which includes the State of Colorado, and the Territories of New Mexico, Wyoming, Montana and a portion of Dakota (the Black Hills). This division has its headquarters at Denver, and is under the supervision of Mr. S. F. Emmons, geologist-in charge. They have been occupied during the past year in preparing a report upon the mineral wealth of Leadville. This report will be illustrated by large and accurate geological and topographical maps—one of the Mosquito range, a more detailed map of the immediate vicinity of Leadville, and still more detailed maps of Fryer, Carbonate, Iron and Breece hills, showing the underground workings of the various mines, each map to be accompanied by numerous sections illustrating the position of the different geological formations and of the ore bodies. The topography has been done by Mr. A. D. Wilson, chief topographer of the survey, formerly of the Hayden survey; the geology by Mr. Emmons and his assistants, Mr. E. Jacob and Mr. C. W. Cross.

From the material gathered it is designed to prepare tables of mineral products, geological and geographical distribution of ores, discussions of systems of working mines, processes of reduction of ores, relative costs of supplies and material consumed.

CENTRAL AFRICA.

Central Africa loses none of its attractions for scientific, commercial and missionary explorers. Greater progress and more wonderful results are near at hand. The frequent expeditions of international and private associations are daily making that vast region better known, rendering the journey to it quicker and safer and cultivating a better understanding between natives and foreigners. A company of capitalists has been formed at Zanzibar with the view to a regular service of transport from the coast to the great central lakes, with a sufficient number of negroes enrolled as a permanent staff of porters. This express company, as it really is, guarantees the safe conveyance of merchandise and luggage, with a great depot midway where travelers can obtain supplies. And, not least, a check will be put upon the brigandage of native chiefs, who, under the pretext of right of way, have compelled caravans to pay an enormous tax at the peril of their whole outfit and life itself.

A NOVEL POST-OFFICE.

The simplest post-office in the world is in Magellan Straits, and has been established there for some years past. It consists of a small cask, which is chained to the rock of the extreme cape in the Straits, opposite Terra del Fuego. Each passing ship sends a boat to open the cask and to take letters out and place others into it. The post-office is self-acting, therefore; it is under the protection of the navies of all nations, and up to the present there is not one case to report in which any abuse of the privileges it affords has taken place.

QUITE SO!

"The stream-lines," said a distinguished Glasgow physicist, "are as represented in the diagram, in which the region of translational velocity greater than wave propagational velocity is separated from the region of translational velocity less than wave-propagational velocity by a cat's eye border pattern of elliptic whirls."

AN ENGINEERING SOLUTION OF A DIFFICULT PROBLEM.

It was Sir John Hawkshaw who proposed to Lord Palmerston to settle the Irish question by offering a bounty to every Irishman that took to himself a Scotch or English helpmate, and a dower to every daughter of the Emerald Isle who wedded a Scotch or English husband. Mr. J. C.

King, of London, has evolved a plan quite as singular and much more practical, and proposes to abolish the island of Ireland. Reversing the processes of M. de Lesseps, this bold Briton seeks to create an isthmus and to separate two seas. He points out the fact that the water-passage between the Mull of Cantyre, in Scotland, and Tor Point, in Antrim, is but 19 miles wide and 474 feet deep in the middle, the water towards either shore being much shallower. Here he would make his artificial isthmus. The high bluffs of Cantyre on the Scotch coast and the still higher land comprising Mounts Clady, Escort and Carnlea on the Irish coast—from 900 feet to 1,200 feet high—offer facilities for gravitating the materials requisite to form the isthmus between the opposite shores. The superficial extent of land required would be little more than a square mile, the average breadth and depth about 100 yards. Not only would a large quantity of marshy land be thus reclaimed, but "the more perfect homogeneity of the united peoples" would, he hopes, be obtained. It would be a little odd if the generation which has seen the Atlantic cable laid, Asia circumnavigated, the Isthmus of Suez pierced and tunnels driven under the Alps, and which is likely to see the ocean crossed by balloons and trains running from Calais to Dover, should also see the three kingdoms of Britain knocked into one and the Green Island converted into a Green Peninsula.

THE FIRTH OF FORTH BRIDGE.

There is something novel in these days in recording the abandonment of a vast scheme of railway engineering. This, however, is the fate of the scheme for bridging the Firth of Forth. The bridge, as originally designed, was to have been one of the new wonders of the world. It would have surpassed the Tay bridge almost as far as that unfortunate structure surpassed similar works. It has been given up solely on the ground of expense. The Board of Trade has very properly insisted on applying the lessons taught by the fall of the Tay bridge; and the directors think the new requirements as to strength and solidity are too costly to be complied with. The advantage to be derived from shortening the route from the capital along the east coast of Scotland is, in fact, not of sufficient value to pay for the vast works it would require. Railway companies have been too ready to lavish capital on undertakings which are more striking as engineering works than profitable as investments, and the disaster to the Tay bridge has checked the disposition to combine boldness of design with cheapness of execution. Cheap bridges, such as those which cross the Mississippi at Quincy or Hannibal, are not in accordance with English habits. We believe that there are no great river bridges in the United States over which a train runs at full speed. Just as every train stops where one railroad crosses another, so it lowers its speed to almost the slowest possible movement in crossing a bridge. If this had been the rule in this country the Tay bridge might have been standing, and the Forth bridge might have been built on the original scheme. But bridges made for full speed must be made as solid as engineering skill can make them.—*London News.*

CORRESPONDENCE.

C. L. F.—There is a penalty attached to sending a written letter in third or fourth-class mail matter, and prepaid only as such. See Section 233, P. L. & R. ENGINEERING NEWS will not, knowingly, be a party to the slightest violation of the laws and regulations of the Post-office Department, and we will certainly report the next irregularity of the above description that occurs. We will be obliged if you will not bore us with any more of your matter, either in manuscript or print.

ERRORS IN SHUNK'S "FIELD ENGINEER."

MAINE CENTRAL RAILROAD,
PORTLAND, Feb. 4, 1881.

EDITOR ENGINEERING NEWS:

DEAR SIR.—Referring to errors in published tables as noted in some of your recent numbers, Mr. Shunk in his recently published "Field Engineer," has fallen into some of the same errors noticed in Mr. Henck's "Field Book." Thus, on

Page 164, 1/138 reads 11.7473444; should read 11.7473401.
Page 175, 007² reads 444899; should read 444889.
Page 177, 1/936 reads 7.829406; should read 7.819406.

I also note that throughout Mr. Shunk's entire work Table XV. is referred to as Table XVI.

Yours truly, WILLIAM A. ALLEN.

ENGINEERS' SOCIETIES.

WESTERN SOCIETY OF ENGINEERS.

The following were elected for the year to serve as officers of the above society: President, E. S. Chesbrough; First Vice-President, Moses Lane; Second Vice-President, D. C. Cregier; Treasurer, Charles FitzSimons; Librarian, John W. Weston; Trustee, R. J. McClure; Secretary, L. P. Morehouse.

AMERICAN INSTITUTE OF MINING ENGINEERS.

SECRETARY'S OFFICE,
Lafayette College, Easton, Pa.

PHILADELPHIA MEETING, BEGINNING FEB. 15, 1881.

The discussion of the subject of "Steel Rails" will be held on Thursday morning, 17th inst., at 10 o'clock, in the hall of the Franklin Institute, Seventh street, below Market.

The following papers are to be discussed: "Rail Specification and Rail Inspection in Europe," by C. P. Sandberg, C. E., and "The Wearing Power of Steel Rails," by Dr. C. B. Dudley.

T. M. DROWN, Secretary.

PROGRESS OF THE ST. GOTHARD RAILWAY.

[From the London Daily News.]

GENEVA, Dec. 20.—The Leggestein spiral tunnel, of whose completion I have already informed you, is one of the most remarkable engineering works of the St. Gothard Railway, and second in importance only to the great tunnel itself. The leading feature of the scheme adopted by the engineers in constructing the line has been to keep to the bottom of the valleys—on the north side of the Alps, the valley of the Reuss; on the south side that of Ticino—and so long as they did not deviate too widely from the required direction, to follow their windings until the point fixed for the entrance of the great tunnel should be reached. When this could not be done, and it became necessary to carry the railroad higher, spiral, or, to use the German term, "turn tunnels," were to be pierced through the mountains. These tunnels made at once a steep gradient and a sharp curve.

The gradient of the Leggestein tunnel is 23 in the 1,000, and it describes a curve of 300 meters. After leaving it the line winds spirally outside the mountain, and, passing through a shorter passage higher on, reaches the required altitude. The construction of this tunnel was difficult, less on account of its length, which is nothing extraordinary, than owing to the necessity of boring entirely by hand through a mass of almost impenetrable granite. The progress made at the outset did not exceed twelve inches in twenty-four hours, even with blasting. The necessity of hand work arose from the absence of water, and the impossibility, in the circumstances, of using steam for the perforators.

Two other turn tunnels in the valley of the Reuss, that of Wallington, 1,000 meters long, and that of Pfaffensburg, 1,488 meters long, will be completed during the coming spring. The former, like the Leggestein, is being bored by hand, the latter by water power. On the south side, in the valley of the Ticino, there are four tunnels (which are to Alpine railways what locks are to canals) of from 1,500 to 1,600 meters long now in course of construction. All these are being bored by water power, and, like those on the north side, are expected to be finished early in 1881.

It is intended to light the great tunnel by electricity. To this end two systems have been proposed. One is to place in the passage forty electric lamps, each possessing a capacity of 1,200 candles. The interval between each lamp would be about 400 yards, and the necessary motive power would be supplied by the turbines at Airolo and Goeschenen, which have been used for moving the perforators and ventilating the workings. The second proposal, whether it be practical or not, has certainly the merit of greater originality. According to this scheme a locomotive impelled by compressed air would be stationed at either portal of the tunnel. These locomotives, being smokeless, would be used for drawing the trains through the tunnel. Each locomotive would carry two electric lamps, and two would be placed at the end of the train, together with reflectors, so arranged that their united light would be equal to that of 12,000 candles. By this means, wherever there was a train, and for a considerable distance before and behind it, the tunnel would be brilliantly lighted at a comparatively trifling expense, the electricity being produced and the engines provided with their motive power by the turbines at Goeschenen and Airolo.

SOMERSET & CAMBRIA RAILROAD, PENN.

DISTANCE AND ELEVATIONS AT STATIONS AND PROMINENT POINTS.

STATIONS.	Distance in Miles	Distance in Miles.	Elevation Above Tide Water.
Rockwood		00	1,808
Sanner's	1.4	1.4	1,830
Shamrock	1.7	3.1	1,868
Milford	1.7	4.8	1,916
Strathmore	1.5	6.3	2,006
Robertus	0.8	7.1	2,026
Somerset	2.1	9.2	2,101
Geiger's Summit	2.6	11.8	2,204.5
Cupp's Siding	0.7	12.5	2,153
Snyder's Mills	1.4	13.9	1,999
Friedensburg	2.2	16.1	2,025
Pile's Siding	0.9	17.0	2,023
Coleman's Mills	0.5	17.5	2,010
1st Crossing Stony Creek	3.2	20.7	1,821
Stoyestown	0.8	21.5	1,771
Sprucetown	0.4	21.9	1,756
Rowena	1.7	23.6	1,710
2d Crossing Stony Creek	2.1	25.7	1,085
Hooversville	0.8	26.5	1,671
3d Crossing Stony Creek	0.1	26.6	1,659
Dolls' Run	2.0	28.6	1,606
Bethlehem	3.3	31.9	1,535
4th Crossing Stony Creek	0.2	32.1	1,533
Astola	1.7	33.8	1,480
5th Crossing Stony Creek	0.5	34.3	1,460
Kaumman's Run	1.0	35.3	1,415
Rahmsville	1.2	36.5	1,350
Paint Creek	1.1	37.6	1,320
Ingleside	0.6	38.2	1,296
King's Mills	2.1	40.3	1,239
Hog Back Tunnel	0.9	41.21	1,218
Hog Back Tunnel	0.05	41.26	1,215
6th Crossing Stony Creek	0.2	41.5	1,204
Ferndale	0.7	42.2	1,190
7th Crossing Stony Creek	1.3	43.5	1,181
Johnstown	1.6	45.1	1,170

NOTE.—The elevations given in the above table indicate sub-grade which is 18 inches below top of rail.

H. B. BAYLOR,
Resident Engineer,
Somerset & Cambria Railroad.

A PORTUGUESE COLONY.

The Portuguese Government has determined upon founding agricultural colonies of Europeans in Angola, and the customs duties levied upon wines and spirits are to be set aside for that purpose. A loan of $5,000,000, to be repaid by the African colonies, is to be raised for the construction of roads and public works, and, in order still further to show the interest which the home government takes in the project, Don Carlos, the Crown Prince, will pay the colonists a visit, attended by the Minister of the Marine.

ELECTRICITY AT THE BRUSSELS CONGRESS.

At the recent Congress of Commerce and Industry held at the Brussels Bourse, in connection with the International Exhibition, the latest developments of electricity, namely, telephony, electric lighting and the transmission of motive power, were the subjects of three very able papers. M. Bède, a past professor of the Liége University, in treating of telephone exchanges, strongly recommended the use of phosphor-bronze for wires instead of iron, owing to its electric conductivity being four times greater than that of iron, and its tensile strength from three to four times greater than that of steel. Aerial wires are more easy of inspection than underground ones, but they are dangerous to life and property, and M. Bède very justly remarked that the inventor who would devise a cheap mode of constructing underground lines, permitting of ready access, would render a great service to telephonic progress. MM. De Backer and Desguin, Belgian government mining engineers, in a very exhaustive paper on electric illumination, showed that a better system of lighting tended to increase the powers of industrial production, and defined the desired qualities of electric lighting apparatus to be the efficiency of the generator, and regularity of action, small size, low price, and easy maintenance of all the apparatus. In discussing electrical prime movers, MM. Davreux and Evrard, engineers, pointed out that since large steam engines were more economical than small ones, it became profitable to found central stations for the supply of local power by means of electricity, which could be led, by means of wires, more easily and economically than compressed gases, without risk of explosion, as in the case of steam, and without polluting the atmosphere.

LIST OF WATER-WORKS IN THE UNITED STATES AND CANADAS.

January 1, 1881.

(Those marked * are private enterprises.)

Compiled by E. PRINCE, C. E., Quincy, Ill.

Birmingham,* Ala.
Huntsville, "
Jacksonville, "
Mobile,* "
Montgomery,* "
Prescott, Arizona Ter.
Little Rock,* Ark.
Anaheimo, Cal.
Columbia, "
Dutch Flat, "
Gilroy,* "
Grass Valley, "
Los Angeles,* "
Marysville,* "
Modesto, "
Missan San Jose "
Nevada City, "
Oakland,* "
Petaluma,* "
Placeville, "
Red Bluff "
Sacramento, "
Santa Barbara,* "
San Francisco,* "
San Jose,* "
San Quinlan, "
San Rafael,* "
Salinas City, "
San Diego, "
Stockton, "
Santa Cruz, "
Vallejo,* "
Watsonville, "
Washington, Yolo Co., "
Woodford, Yolo Co., "
Yreka, "
Ansonia,* Conn.
Bethel, "
Birmingham,* "
Bridgeport,* "
Danbury, "
Greenwich, "
Hartford, "
Meriden, "
Middletown "
Milford, "
New Britain, "
New Haven,* "
New London, "
New Milford, "
Norwalk, "
Norwich, "
Rockville,* "
Shelton, "
South Norwalk, "
Stamford,* "
Stonington, "
Walcottville,* "
Waterbury, "
Winsted, "
Bodie, Col.
Boulder, "
Caribou, "
Cañon City,* "
Central City,* "
Colorado Springs, "
Denver,* "
Golden, "
Leadville,* "
Pueblo, "
Silver Cliff, "
Trinidad,* "
Deadwood, Dakota.
Newcastle,* Del.
Wilmington, "
Washington, D. C.
Jacksonville, Fla.
Atlanta, Ga.
Augusta, "
Rome, "
Savannah, "
Silver City, Idaho Territ'y.
Alton,* Ill.
Bloomington, "
Charleston, "
Chicago, "
Decatur, "
DeKalb, "
Dixon, "
Elgin, "
Evanston, "
Hyde Park, "
Jacksonville, "
Lake, "
Lake View, "
Litchfield, "
Moline, "
Oregon, "
Paris, "
Pekin, "
Peoria, "
Quincy,* "
Rochelle, "
Rockford, "
Rock Island, "
Springfield. "
Sterling, "
Sycamore, "
Waukegan, Ill.
Attica, Ind.
Brazil, "
Brookville, "
Columbus, "
Connersville, "
Evanston, "
Evansville, "
Fort Wayne, "
Indianapolis,* "
Jeffersonville, "
Kokomo, "
LaFayette, "
Laporte, "
Logansport, "
Madison, "
Marion, "
Michawakee, "
New Albany,* "
New Carlisle, "
Peru, "
South Bend, "
Terre Haute,* "
Union City, "
Washington, "
Anamosa,* Ia.
Atlantic, "
Burlington,* "
Cedar Rapids,* "
Clinton,* "
Davenport,* "
Des Moines,* "
Dubuque,* "
Keokuk,* "
Lyons,* "
Marengo, "
Marshalltown, "
Monticello, "
Mt. Pleasant, "
Muscatine,* "
Oskaloosa, "
Ottumwa,* "
State Centre, "
Blue Rapids, Kan.
Emporia, "
Fort Scott, "
Bowling Green, Ky.
Covington, "
Frankfort, "
Henderson, "
Louisville,* "
Maysville, "
Newport, "
Owensboro, "
Pleasant Hill, "
New Orleans, La.
Auburn,* Me.
Augusta,* "
Bangor, "
Belfast, "
Biddeford,* "
Houlton, "
Lewiston, "
Portland,* "
Rockland,* "
Waterville, "
Annapolis,* Md.
Baltimore, "
Cumberland City,* "
Frederick, "
Frostburg, "
Morganza, "
Amherst, Mass.
Arlington, "
Athol,* "
Attleboro, "
Beverly, "
Boston, "
Brighton, "
Brockton, "
Brookline, "
Cambridge, "
Charlestown, "
Chelsea, "
Cheshire, "
Chicopee,* "
Concord, "
Danvers, "
East Hampton, "
East Saugus, "
Everett, "
Fall River, "
Fitchburg, "
Great Barrington,* "
Greenfield, "
Haverhill,* "
Hingham, "
Holyoke, "
Kingston,* "
Lawrence, "
Lenox,* "
Leominster, "
Lincoln, "
Lowell, "
Lynn, "
Malden, "
Medford, "
Melrose, "
Methuen, "
Marblehead, "
Middleboro, Mass.
Milford; "
Natick, "
Nantucket, "
New Bedford, "
Newburyport, "
Newton, "
North Adams, "
North Bridge, "
Northampton, "
Orange, "
Peabody, "
Pittsfield, "
Plymouth, "
Quincy, "
Reading, "
Salem, "
Shelburn Falls, "
Somerville, "
South Adams, "
South Hadley, "
South Lee,* "
Springfield, "
Stockbridge,* "
Taunton, "
Warren, "
Watertown, "
Waltham, "
Westborough, "
West Brookfield,* "
Westfield, "
West Springfield, "
Winchester, "
Woburn, "
Worcester, "
Adrian, Mich.
Allegan, "
Almont, "
Alpena, "
Ann Arbor, "
Bay City, "
Big Rapids, "
Cadillac, "
Constantine, "
Detroit, "
East Saginaw, "
Grand Haven, "
Grand Rapids, "
Holly, "
Ionia, "
Jackson, "
Kalamazoo, "
Marquette, "
Muskegan, "
Niles,* "
Plainfield, "
Plainwell, "
Port Huron, "
Portland, "
Saginaw, "
St. Louis, "
Tecumseh, "
Warmouth, "
West Bay City, "
Mankato, Minn.
Minneapolis, "
St. Paul,* "
Stillwater, "
Winona, "
Columbus, Miss.
Carthage, Mo.
Hannibal,* "
Kansas City,* "
Sedalia, "
St. Joseph,* "
St. Louis, "
Joplin, "
Omaha,* Neb.
Nebraska City, "
Grand Island, "
Austin City, Nev.
Eureka,* "
Gold Hill,* "
Hamilton, "
Pioche,* "
Virginia City,* "
Bethlehem, N. H.
Claremont,* "
Concord, "
Dover* (3 com.), "
Farmington, "
Great Falls, "
Keene, "
Manchester, "
Nashua,* "
Portsmouth,* "
Atlantic City, N. J.
Bergen, "
Bloomfield, "
Bridgeton, "
Bordentown,* "
Burlington, "
Camden, "
Cape May, "
Elizabeth,* "
Flemington, "
Hackensack,* "
Hackettstown, "
Hudson City, "
Jersey City, "
Lambertville, N. J.
Long Branch. "
Millville,* "
Morristown,* "
Mt. Holly,* "
Newark, "
New Brunswick, "
Passaic,* "
Paterson,* "
Phillipsburg,* "
Rahway, "
Trenton, "
Albany, N. Y.
Andes, "
Attica, "
Auburn,* "
Avon,* "
Balliston Spa, "
Batavia, "
Bayside, "
Binghamton, "
Brooklyn, "
Buffalo, "
Canajoharie, "
Clifton Springs, "
Cohoes, "
College Point, "
Cooperstown,* "
Corning,* "
Dansville, "
Delhi,* "
Dunkirk,* "
Edgewater, "
Ellenville, "
Elmira,* "
Flushing, "
Ft. Edward,* "
Fredonia, "
Garden City,* "
Geneseo, "
Geneva,* "
Glens Falls, "
Gloversville, "
Goshen, "
Governeur,* "
Hudson, "
Ithaca,* "
Jamestown,* "
Johnstown, "
Leroy, "
Lockport,* "
Long Island City, "
Lyons, "
Malone, "
Medina, "
Middletown. "
Newburg, "
New York City, "
Niagara Falls,* "
Norwich, "
Ogdensburg, "
Oswego,* "
Owego,* "
Peekskill, "
Port Byron, "
Port Jervis,* "
Port Richmond, "
Potsdam, "
Poughkeepsie, "
Prospect Park, "
Plattsburgh, "
Richfield Springs, "
Rochester "
Rome, "
Saratoga Springs, "
Schenectady,* "
Suspension Bridge, "
Susquehanna, "
Syracuse,* "
Tennytina, "
Tonawanda, "
Troy, "
Utica,* "
Walton,* "
Whitehall, "
Warwick, "
Warsaw,* "
Watertown, "
Waverly, "
West Troy,* "
Yonkers, "
Fayetteville, N. C.
Salem, "
Akron, Ohio.
Alliance, "
Bellair, "
Bellevue, "
Canton, "
Cincinnati, "
Cleveland, "
Columbus, "
Crestline, "
Dayton, "
East Liverpool, "
Elyria, "
Galion, "
Hamilton, "
Ironton, "
Lancaster, "
Mansfield, "
Massillon,* Ohio.
Middletown, "
New Lisbon, "
Norwalk, "
Piqua, "
Portsmouth, "
Salem, "
Sandusky, "
Sidney, "
Steubenville, "
Tiffin, "
Toledo, "
Urbana,* "
Warren, "
West Cleveland, "
Wooster, "
Youngstown, "
Zanesville, "
Portland,* Or.
Salem, "
The Dalles, "
Allegheny, Pa.
Allentown, "
Altoona, "
Archibald,* "
Ashland, "
Beaver Falls,* "
Bedford, "
Bellfonte, "
Bethlehem, "
Berwick,* "
Birmingham, "
Bloomsburg, "
Blairsville, "
Boyerstown, "
Bristol,* "
Butler, "
Carbondale, "
Carlisle,* "
Catasauqua, "
Chambersburg, "
Chester, "
Clarion, "
Coatesville, "
Columbia,* "
Connemaugh, "
Conshohocken,* "
Corry, "
Danville, "
Downingtown,* "
Doylestown, "
Dunmore, "
Easton,* "
Ebensburg, "
Ephrata, "
Erie, "
Franklin,* "
Germantown, "
Gettysburg, "
Hamorton "
Hanover, "
Harrisburg, "
Hazelton,* "
Hollidaysburg, "
Housedale, "
Huntingdon, "
Jamestown, "
Johnstown*, "
Kennett Square, "
Kittanning, "
Lancaster, "
Lansford,* "
Lebanon,* "
Lewistown, "
Lockhaven, "
Louella,* "
Mahanoy City,* "
Mauch Chunk,* "
Meadville,* "
Mechanicsburg, "
Media, "
Milford*, "
Minersville,* "
Monongahela, "
Mt. Job, "
New Brighton, "
Norristown,* "
Oil City, "
Oxford, "
Parker City, "
Philadelphia, "
Phoenixville, "
Pittston,* "
Pittsburgh, "
Plymouth,* "
Pottstown,* "
Pottsville,* "
Providence,* "
Reading, "
Renovo, "
Reynoldsville, "
Sewickley, "
Scranton,* "
Shamokin,* "
Sharon, "
Shenandoah, "
Slatington, "
South Bethlehem,* "
Stroudsburg, "
Summit Hill* "
Susquehanna,* Pa.
Tamaqua, "
Tioga, "
Titusville, "
Towanda, "
Tunkhannock,* "
Tyrone, "
Westchester, "
West Pittston, "
Wilkes, Barre (2 companies),* Pa.
Williamsport (2 companies),* Pa.
Williamsport W. Co.
Lycoming W. Co.
York, Pa.
Bristol, R. I.
Central Falls, "
Newport,* "
Pawtucket, "
Providence, "
Charleston, S. C.
Columbia, * "
Chattanooga,* Tenn.
Clarksville,* "
Columbia, "
Memphis,* "
Nashville, "
Austin,* Tex.
Dallas,* "
Dennison, "
Galveston, "
Houston, "
San Antonio,* "
Sherman, "
Waco,* "
Salt Lake City, Utah.
Park City, "
Logan City, "
Bellows Falls, Vt.
Brandon, "
Burlington, "
Fair Haven, "
Hyde Park,* "
Rutland, "
St. Albans, "
St. Johnsbury, "
Vergennes, "
Windsor, "
Worcester, "
Alexander,* Va.
Charlottesville, "
Danville,* "
Fredericksburg, "
Lexington, "
Lynchburg, "
Norfolk, "
Petersburg, "
Richmond, "
Staunton, "
University of Virginia, "
Winchester, "
Olympia, Wash. Ter.
Seattle, "
Vancouver, "
Walla Walla,* "
Martinsburg, W. Va.
Wheeling, "
Beloit, Wis.
Janesville, "
Kenosha, "
La Crosse, "
Milwaukee, "
Prairie du Chien, "
Racine, "
Sparta, "
Cheyenne, Wyo. Ter.
Barrie, Can.
Berthier, "
Brantford,* "
East London, "
Kingston, "
London (Ont.), "
Mitchell, "
Montreal, "
Ottawa, "
Owen Sound, "
Quebec, "
Halifax (N. S.), "
Hamilton (Ont.), "
Sarnia, "
Seaforth, "
Sorel, "
St. Catharines, "
St. Cunegonde, "
St. Gabriel, "
St. Thomas, "
St. John (N. B.), "
Three Rivers, "
Toronto, "
Truro, "
Walkertown, "
Windsor, "
Wingham, "
Yorkville, "
Yarmouth, "

THE DESIGN GENERALLY OF IRON BRIDGES OF VERY LARGE SPAN FOR RAILWAY TRAFFIC.

BY THOMAS CURTIS CLARKE, M. A. S. C. E.; M. INST. C. E.

(*Concluded from page 59.*)

Mr. MAX AM ENDE would give a few results of some calculation he had made on an *à priori* method of calculating the weights of girder bridges. He had applied the method to girder bridges of more than 500 feet span, and especially to four different kinds of girder: the straight girder with vertical struts and diagonal ties; the straight girder with diagonal struts and diagonal ties; the parabolic bowstring girder, and the parabolic fish girder. He found that in the case of the first girder for 500 feet span the best proportion of depth to span was about $\frac{1}{10}$. It then increased, and became infinite at the limiting span, which was for iron of 5 tons strain per square inch about 2,870 feet. For the second girder the limiting span was about 4,000 feet for iron, and for steel of 7½ tons strain 6,000 feet. The depth at the limiting span was infinite. The third girder had also a proportion of $\frac{1}{8}$ at first, and of $\frac{1}{6}$ at the limiting span of about 3,000 feet, the corresponding depth being 1,830 feet. The fish girder had a limiting span of 4,200 feet for iron and 6,300 feet for steel, the corresponding depths being 3,600 feet and 5,400 feet. Those most economical depths were certainly much greater than had hitherto been assumed. But he found that the minimum of material was approached very gently, and that therefore, by reducing these depths considerably, the weight of the bridge would not be much increased.

Mr. G. WHITEHEAD, of the Hull Forge Company, as a manufacturer of bridge-links, should be glad to describe the mode in which they are made at his works. These works were constructed entirely for the manufacture of scrap iron. The old scrap was rolled into bars, which were cut up and formed into a pile sufficiently heavy to make a link of the full dimensions. After the pile was thoroughly hot and the ends of the links formed under the hammer, the pile was taken to the mill and rolled out; the ends were then cut, and there was the link in a substantial form. The tests by Mr. Kirkaldy showed that the permanent set was 13 tons. After it was broken, it would reduce in area about 25 per cent. The process was simple, economical, and efficient. The holes were drilled after the links were cooled. It would be impossible to get them uniform in distance if they were punched. The iron could not be heated twice to regulate the distance, and he believed that the distance between the centres of the links was imperative. It was thought, by the engineers for whom they were making the links, that it was better and safer to drill the holes than to have them punched or hammered, or made by hydraulic pressure while hot.

Dr. SIEMENS remarked that it was stated in the paper that the strength at which the iron was to be tested was equal to 60,000 lbs. (nearly 30 tons) to the square inch, and that it was to be subjected only to 10,000 lbs. of strain in tension. Surely there must be some error in that statement, as he knew of no iron that would stand a breaking weight of 60,000 lbs., except puddled steel, which was not the material used according to the specification, and if such iron could be obtained, the weight with which it was to be loaded, viz., 10,000 lbs., appeared needlessly small, being equal to ⅓ only of the total breaking weight. American engineers, if the author represented them correctly, had very little confidence in steel as a building material. Perhaps he might be allowed to make a few remarks with regard to that material, to which he had paid considerable attention. A distinction ought to be drawn between steel and steel. There was a material called steel, but which, in reality, was the purest iron ever introduced to notice of engineers. It contained 99.6 per cent. of metallic iron, and only 0.4 per cent of foreign matter of every description, whereas the best so-called iron contained between 3 and 4 per cent. of foreign material. Mild steel was really iron of the best character, and he could not conceive how such a material could be thought unreliable in its application. It was produced, not like puddled iron, in small quantities to be welded together with the chance of inclosing foreign matter, and producing irregular results; but it was produced in large masses—10 or 12 tons of fluid substance—and there was every probability that such a material was uniform to the utmost degree. Practice had, indeed, fully substantiated the fact that there was no material more uniform than that very mild steel. It would bear 28 tons breaking strain to the square inch, simply because it was iron, for no one would pretend that cinder would bear a strain equal to that of iron. In mixing between 3 and 4 per cent. of cinder with the iron, some of its strength must necessarily be lost; otherwise it had all the qualities which iron ought to possess. But for engineering purposes he would restrict the use of very mild steel. It was excellent for the construction of boilers, and for the construction, perhaps, of continuous girders, because it was very reliable. It might be loaded to one-half its breaking strain without any sensible permanent set, and if it were loaded beyond that, it would not rupture, but it would elongate to the extent of 25 per cent.; therefore, in constructing a girder bridge of such material, the chances were that it would bend down to the bottom of the river rather than break. But it was not the strongest material that could be used. In the New York bridge, which he saw in progress last year, the steel wire was tested to nearly 100 tons per square inch. In his own practice he generally applied 80 or 90 tons as the weight which steel wire, for telegraphic purposes, ought to bear. But between the two limits—between the material that would bear a breaking strain of 28 tons, and elongate 25 or 30 per cent. before breaking, and the highly wrought material which would bear 80 or 90 tons to the square inch—there were a great many steps, all of which were applicable under circumstances such as practice must indicate. For links, he should consider that a material capable of bearing from 45 to 50 tons to the square inch would be the best material. It would be sufficiently yielding to excessive strain; it would yield 10 per cent. before rupture took place, and at the same time it could be loaded to certainly 15 tons to the square inch with safety. In constructing long bridges, the difference was so great, whether using a material that could be loaded safely and practically with 15 tons, or a material safely bearing a strain of only 5 tons, which was the limit now imposed upon iron, that there could be no question, in the long run, which was the right material for such large structures as were referred to in the paper. As regarded compressive strain, steel must be looked upon as potentiated wrought-iron, bearing a strain of compression equal to that of extension; but it must be borne in mind that the smaller scantling of the steel under compression necessitated a change in construction with a view to giving the requisite amount of lateral support; it was therefore not sufficient to make a design in iron and reduce the scantlings in substituting steel, as had been the practice to some extent.

Mr. CLARKE, in reply, said he entirely concurred in the remarks of Dr. Siemens, except in regard to the doubt he had expressed whether American iron would bear 60,000 lbs. strain per square inch. It was certainly rather an unusual specification. American engineers were generally contented with from 50,000 to 55,000 lbs.; but in the case in question, the specification absolutely called for 60,000 lbs., and experiments proved that this strength had been obtained. Reference had been made to a 6,000-feet span, with a height of 1,800 feet. But those were purely theoretical figures, and they took into account simply the forces of gravity. A bridge was a complex structure. It had to bear not only the forces of gravity, but also the side pressure of the wind. Mr. Young had stated that it was a simple matter to provide against the force of wind; but that was really the most difficult and complicated part of the problem. The most economical depth possible had to be used to resist the force of gravity; but then the side pressure prevented the use of an economical height; consequently the bridge, when it was finished, was a compromise between the results of the two forces. That was why the long-span bridges were comparatively not so high as those of shorter span. In spans of less than 200 feet the proportion was ⅓ or ¼. The Kentucky bridge alluded to by Mr. Fox was really a discontinuous girder, and the proof of it was, that, when the test loads ran over it, there was a movement of the lower chords at the point where they were cut. The comparing of the moduli of elasticity of the irons was simply an experiment, and it was done in this case to test the very theory of discontinuous girders. With regard to the platforms, he was sorry to say that there were many bridges in America of which the platforms were not so strong as they ought to be; but every day approximation was made to the English practice in that respect. American engineers looked with the greatest respect and favor upon English practice; they admired the safety which English engineers gave to their bridges, and wherever it was possible, whenever bridges were planned by engineers, the platforms were now made much stronger than the girders; while the girders, in the long span, carried about 1 ton to the foot-load, the platforms, with the same strain, were made to carry from perhaps 2 to 2½ tons. Mr. Matheson had spoken of the difficulty of rolling one of the bridges out. He could not think that that was an objection, when it was seen that it could be corbelled out. With regard to Mr. Phipp's objection to vertical members, the reason why American engineers preferred them was that there might be no reversal of strain. It would be easy to use triangular or Warren girders in which the members should be placed alternately in tension and compression—that they should be stiffened members and at the same time made to resist tension; but in the bridges in question every member was strained only one way; the posts and the upper members were strained in compression; the lower members and diagonals were strained in tension; there was no reversal of strains, and that was thought to conduce to the longevity of the bridge. Mr. Barlow considered that the modulus of elasticity of steel had been spoken of by him as uncertain. On the contrary, his views agreed entirely with those of Mr. Barlow that the modulus of elasticity of steel was less variable than of iron. What was said by him was "its strength is variable," and that needed a little explanation. In forms of regular section, like plates and angles, the strength of steel was not necessarily variable; but where the sections were subject to sudden changes of form, as in eye-bars, the strength of steel was variable. In eye-bars of iron, as made at Phœnixville, and at several other large American bridge works, the eye was not welded to the bar, but the bar was upset, or dieforged under hydraulic pressure, into the exact shape required. Care had to be taken neither to burn the iron nor to distort its fibers. That was so well understood that specifications now demanded that iron eye-bars should always break in the bar, never across the eye. It had taken some time to learn how to do that in iron. If bridges were to be built of steel, engineers would not be willing to give up what they considered to be the very decided advantage of eye-bars and pins. Before they could venture to use steel eye-bars, a series of very careful experiments would have to be made: first, to determine the proper mode of manufacture of steel eye-bars, and then to ascertain the proper proportion of areas of eye to bar, and of the curves uniting the two. That had not been done yet, for the reason given by him, that the present price of steel was too high in America, as compared with that of iron, to make its use economical in girder bridges. In reference to the table p. 27 *ante*, it was stated that the strains on the Kuilenburg bridge, No. 15, were 11,800 in compression and 14,560 in tension. Mr. Van Diesen, the engineer, had stated that those were the strains on the cross-girders, which were of Bessemer steel, and no such strains existed in the main girders. He did not say what the maximum strains were, but if they did not exceed 4 tons per square inch in compression and 5 tons in tension, then the comparison with the Ohio bridge, No. 16, would be more favorable. It was believed that equating the two bridges for lengths, widths, loads carried, and strains per square inch, would reduce the excess of weight of No. 15 over No. 16 at least one-half of the amount previously given, or, say, to 310 tons. Mr. Baker had pointed out that an error in length of an eye-bar of $\frac{1}{64}$ inch might increase the strain 1½ tons per square inch. It might increase it much more than that. If a certain load was carried by a set of eye-bars in any frame, and one bar should be $\frac{1}{64}$ inch shorter than the others, it would have to carry the whole load belonging to the four unless it stretched $\frac{1}{64}$ inch. But that irregularity of lengths never had occurred, at least in his practice. Care was taken that all struts intended to be of the same length should be exactly of the same length. The process of manufacture insured that. The holes were drilled at each end of the eye-bar at the same time on a tool with a wrought-iron bed long enough to support the longest bar. The struts also were milled to length at both ends simultaneously. The limit of error of $\frac{1}{64}$ inch referred to was that allowed in transferring dimensions from the drawings to the template or machine tool. Eye-bars 45 to 55 feet long were made at Phœnixville, so that a dozen might be piled on the top of each other. A long pin exactly filling the holes was put through them at one end, and if another similar pin would not go smoothly and easily through all the holes at the other end, the bar which should refuse to admit the pin would be rejected. Such accuracy of workmanship cost no more than ill-fitting work when once the machine tools and proper appliances were prepared. The application of machinery to the construction of pin and eye-bar bridges was of the same kind as that now applied to the construction of rifles, sewing-machines, etc. His

experience led him to believe that the fears sometimes expressed of loose joints were quite unfounded when bridges were made in that way.

Mr. BERKLEY described, through the secretary, the way in which bars had been made for him by Messrs. Westwood, Baillie & Co., since Messrs. Howard & Ravenhill had ceased to manufacture them.

From a bar of iron (fig. 8), the full width of the swelled head, the portions *A A A* were stamped out at the same time under the steam hammer. The pin-holes, stamped at the same operation, were about ¾ inch less in diameter than the finished size, being afterward bored out to the requisite dimensions. After the heads had been thus formed, the links were then taken to a planing machine, and the two strips *B B* were planed off the bar in the usual manner. The pin-holes being then bored out to the finished size at one end, a number of the links were stacked on each other, the links being dropped over a stud of the exact size of the pin, and the pin-holes at the opposite end were then bored out. The shape of the heads of the links was in accordance with the proportions stated in his paper on "The Strength of Iron and Steel."* Some

FIG. 8.

links had been tested; three of them broke at the head, as shown in fig. 8, five through the bars, and ten did not break, but stretched more than 9 inches in the length of the bar, which was 8 feet from center to center of the pin-holes, being the limit of the machine. The maximum breaking strains were 21.8 tons and 20.9 tons per square inch of section of bar; but one of the bars which did not break bore a strain per square inch of section of bar equal to 22.22 tons.

Mr. W. H. BIDDER observed, through the secretary, that the author appeared to have rather overestimated the quantity of material required to span an opening of 710 feet clear, to carry a double line of way. In his first example of an ordinary girder, he estimated the gross amount of iron required to be 4,500 tons; but he thought that this was in excess at least 500 tons, and that much of this excess was due to the great obliquity of the diagonals in the sides making them longer and the strains on them greater than necessary. He was at a loss to understand why the diagonals were so much inclined towards the horizon, and also why the author had adopted four main girders for his example. Mr. Bidder had found that, where the main girders, transoms, longitudinals, and deck-plating of a bridge were all of iron, for all practical purposes the quantity in tons of iron required might be estimated as follows: For spans of from 100 feet to 300 feet, with either two or three main girders. Where there were only two main girders, the weight of each would be found by squaring the span in feet and dividing the result by 300, and the weight of the transoms, longitudinals and deck-plating would be found by multiplying the span in feet by 0.6. For three main girders, the same formula for each main girder, in the case of two girders only being adopted, would apply to the center one; and for each side girder the weight might be found by squaring the span in feet and dividing the result by 500. The weight of the transoms, longitudinals and deck-plating would be found by multiplying the span in feet by 0.44. If the weights of the main girders proved heavier than by calculation from the above formula, then there was something wrong in the design. But for spans above 300 feet the divisions might be somewhat reduced; and, in the case of the span of 720 feet, the divisors might be 340 and 520 respectively, instead of 300 and 200, as taken for spans up to 300 feet. The several cases would then stand thus:—

For two main girders only—

	Tons.
One main girder $\frac{span^2}{340} = \frac{720^2}{340} =$	1,630
One " " " " =	1,020
Transoms, deck, etc., span × 0.6 = 720 × 0.6 =	432
Add for a top and cross bracing, say	328
Total	4,000

For three main girders—

	Tons.
One main center girder $\frac{span^2}{340} = \frac{720^2}{340} =$	1,020
One main side " $\frac{span^2}{520} = \frac{720^2}{520} =$	990
One main side " " " =	990
Transoms, deck, etc. = span × 0.44 = 720 × 0.44 =	316
Add for top and cross bracing, say	304
Total	4,220

And in the case of four main girders—

	Tons.
One main girder $\frac{span^2}{520} = \frac{720^2}{520} =$	990
Three " " " " =	2,970
Transoms, deck, etc. = span × 0.4 = 720 × 0.4 =	288
Add for top and cross bracing, say	292
Total	4,540

The preceding calculations were based on the assumption that no portion of the metal was strained beyond 4 tons to the square inch in compression, and 5 tons per square inch in tension. But the top and bottom members, for several feet from the ends of the girders, could not be diminished to anything like the extent required to produce a strain of 4 and 5 tons per square inch respectively, as in the other portions of the girder; and, indeed, nearly all the compressive members were subjected to a less strain than 4 tons to the inch, in order to keep them from buckling, particularly when they were so long that they came under the laws of long columns. Thus the waste of material would increase with the greater number of girders; hence, for a span of 720 feet, when only two main girders were adopted, the gross weight was only 4,000 tons; with three main girders, it was 4,220 tons; and with four main girders, 4,540 tons, or just the quantity estimated by the author; consequently, the lesser number of girders ought to be adopted, particularly as, on account of the greater masses of material in the various members with fewer girders, there would not be so many surfaces subjected to the weather, and greater durability would be insured. With these remarks he would like to add, that, in all the works which he had read, and in all the speeches that he had heard on the subject of the strains in structures, he knew of none that had been so much abused from the want of the application of common sense, and which had produced more curious ideas.

Mr. C. ELWIN observed, through the secretary, that in bridges of long span any saving of dead weight was obviously of great importance. In flanges composed of plates riveted together, the joint covers formed a large item in this weight, the width of flange necessary to give stiffness, and to make up the large amount of sectional area required was such, that the limit of length of the plates, when they were made the whole width of the flange, was soon reached, and the number of joint covers was proportionately great. But if each layer of plates was made up of two or more widths, one say 4 inches more and one 4 inches less than the half width of the flange; and if these wide and narrow plates were placed alternately on each side of the flange, so as to break joint, much longer plates could be used, and a corresponding reduction gained in the number of covers required without loss of strength, and with only a small increase in the amount of work to be done. He had adopted this system in the main girder flanges of the floating dock recently constructed for the Victoria Graving Docks, the width of flange being 72 inches, and each layer containing one plate 40 inches and one plate 32 inches wide. He was not aware whether this system had been used before in the flange of a girder.

Sir C. A. HARTLEY remarked, through the secretary, that having inspected some of the most important railway bridges in the United States, he was able to indorse the author's statement that iron railway bridges of long spans in that country were conspicuous for economy of design, and generally for excellence of workmanship. In the session of 1874-5, the Council of the Institution did him the honor to publish as a selected paper, his "Notes on Public Works in the United States and in Canada."* In that paper short accounts were given of Mr. Albert Fink's railway bridge across the river Ohio, at Louisville (not at Cincinnati, as written by mistake in the "Notes"), and of Mr. C. Shaler Smith's railway bridge across the Missouri at St. Charles. He now desired to refer to these two bridges as being notable types of American iron bridges of large spans, the Louisville bridge having among its twenty-seven spans one span of 400 feet and one of 370 feet; and the St. Charles bridge having four spans of 320 feet and three of 305 feet. In the Louisville bridge the total weight of wrought and cast-iron in the 400-feet span was 627 tons, and the total dead weight of the span, including its two over-hanging side-paths, was 743 tons, or 4162 lbs. per lineal foot. The bridge, in addition to its own weight, was proportioned for a rolling load of 2,600 lbs. per lineal foot, and with this maximum load the factor of safety in the cast-iron chords was from 6 to 7, and in the wrought-iron braces from 5 to 6, by Hodgkinson's formula. The depth of truss of the 400-feet span, which Colonel Fink called "a modified triangular truss," was 46 feet, or less than ⅛ of the span; the proportion in the wrought-iron trusses of the Cincinnati and Kentucky bridges, specially cited by the author, being ⅛ of the span. The paper was a most valuable one, and would doubtlessly be read with special interest by railway engineers in India, where, as yet, only six bridges had been erected, as far as he could learn, whose spans exceeded 180 feet, *i. e.*, Mr. Bradford Leslie's bridge across the Gorai,† which, besides smaller openings, had seven spans of 185 feet each; the Faun bridge, on the Great Indian Peninsula railway, which had four 196 feet openings in addition to two smaller ones; the bridge across the Chumbul at Dholpore, which had twelve spans of 200 feet and two of 150 feet; the bridges across the Jumna at Allahabad and Delhi, the spans of which were 220 feet; and the bridge across the Sutlej at Bahawulpore, which had sixteen spans of 264 feet each. With the exception of the Bahawulpore bridge, the foundations of which were carried down to a depth of 100 feet, no bridge in the Punjab had greater spans than 142 feet, the precise length, reckoning from centre to center of the piers, of each of the sixty-four wrought-iron trussed spans of the famous bridge across the river Chenab at Wuzerabad. The spans of the bridges across the Jumna at Saharanpore, the Beas at Beas, and the Sutlej at Phillour, did not exceed 112 feet each; while the spans at Lahore across the Ravi, and at Jhelum across the Jhelum, did not exceed 100 feet.‡ After a close inspection of the railway the bridges between the Jumna and the Jhelum, in the spring of 1877, while fully recognizing the admirable manner in which the work had been constructed, he could not help carrying away with him the conviction that if much bolder spans had been adopted more satisfactory results would have been obtained at a far less ultimate cost. In his opinion, the want of sufficient waterway and the general adoption of short spans were the principal causes of the failures that took place nearly every rainy season in the foundations in one or more of the bridges spanning the great rivers flowing through the alluvial plains of India, notwithstanding that the brick cylinders on which the superstructures rested were carried down to depths often exceeding 70 feet below the level of low water. In some cases ⅓ of the waterway was taken up by the too thickly planted piers; and in other cases the evil, inherent to the presence of so many solid obstructions to the free play of the current, was greatly aggravated by the necessity which often presented itself during floods of throwing down masses of rubble-stone, or "kunkur," round the piers to guard their foundations against undue scour, which had been known to scoop out holes 30 feet deep in the space of only a few hours. The ultimate consequences of such additional encroachments on the waterway, if carried out on a large scale, were not difficult to foretell. The lessons taught by the examples referred to seemed to be that in dealing with the bridging of rivers whose beds to an unknown depth had been formed by their own deposits, and where, as in the Punjab, the channels were constantly changing in direction and in depth, owing to the violence of sudden floods and the absence of well-defined river banks, the adoption of wide spans instead of narrow ones would insure greater safety to the structure itself, greater economy in its maintenance, more safety and freedom to the navigation, and,

Vide Minutes of Proceedings Inst. C. E., vol. xxx., p. 215.

Vide Minutes of Proceedings Inst. C. E., vol. xl., p. 169.
†*Vide Ibid.*, vol. xxxiv., p. 1.
‡ *Vide ante*, pp. 61 and 64.

lastly, greater economy in the first cost and future maintenance of the bunds and spurs required in any case to keep such a supposed river, near the bridge, in proper train.

Mr. C. SHALER SMITH stated, through the secretary, that the ice freshet and flood, which destroyed the works at the Ohio bridge, occurred also at the Kentucky River, but owing to the difference in the systems of erection the latter bridge was pushed forward in defiance of the weather, and was completed two months later. The recorded deflections in the first and second conditions of the testing of the Ohio bridge were, in his opinion, more than doubtful. The observations were taken in a driving rain, and the rodman placed on this span was nervous on account of the great height. While they stood as the records of the official tests, neither Mr. Bouscaren, Chief Engineer of the Cincinnati Southern Railroad, nor himself considered them as correct. On the following day a train as nearly the same weight only deflected the middle span 1¾ inch, rendering it almost certain that the two observations of the previous day were erroneous. During three months of the time occupied in the erection of the Ohio bridge, the weather was so exceptionally severe that the work on all the other bridges along the line was suspended. The most signal example of economy shown by the table of particulars of various bridges (Appendix I., p. 35) was that over the Susquehanna River. The Steubenville span was proportioned for 4,000 lbs. working load per foot. Bearing this in mind, it was not so far behind the others as it appeared to be at the first glance. The longitudinal stability of the Kentucky iron piers was required to be such that a train weighing 1,125 tons, with a brake applied to every wheel, and the wheels all sliding on the rails, should not produce tension at any part of the pier leg or base. The specifications in the appendix to the paper required that the piers should have much larger bases to meet lateral and longitudinal stains than had been given to the piers of the great French and Swiss viaducts, in any of which serious tension would be produced during such storms as were common in America. In the case of the Kentucky River bridge it was provided that there should be added to the strains produced by the rolling road 30 per cent. for rail joists, 25 per cent. for floor beams, and 20 per cent. for counter rods; also a pressure of wind of 31½ lbs. per square foot on twice the surface of the spans and iron piers, plus 315 lbs. per lineal foot on the train extended entirely across the bridge. When exposed to these lateral forces the piers were so proportioned as to be without tension at any part of the base.

NOTES.

THE LAW GOVERNING CONTRACTS AS EXPOUNDED BY COMPTROLLER LAWRENCE.

WASHINGTON, D. C., Jan. 4, 1881.—In 1876 the Grahamite & Trinidad Asphalt Paving Company of New York contracted with the government to pave Pennsylvania avenue, this city, for about $200,000, 10 per cent. to be retained for three years after the completion of payment as a guarantee that the pavement would be kept in good condition. The pavement was laid, the contract price, less the 10 per cent. reserve, paid over, and the company kept the pavement in repair for three years, according to contract, thus becoming entitled to the 10 per cent. reserve, $20,191.50, which it invested in government bonds prior to the commencement of the three years' period. However, the company became indebted and felt the need of money. Safford & Co., of Boston, through a New York firm, advanced it $25,000 taking as collateral an assignment of the reserve fund bonds in the hands of the treasurer of the United States. When the three years expired, Safford & Co. applied for the bonds. Meanwhile, however, other creditors of the Grahamite & Trinidad Asphalt Company had procured injunctions to prevent the payment of the reserve to Safford & Co. The matter then came before the first comptroller of the treasury, Lawrence, who, in a long decision just printed, affirms the right of Safford & Co. to receive the reserve bonds assigned to them as collateral. He says: "Executive officers of the government, charged with the duty of making payment to persons designated by law or contract under it, have no authority to require such persons to submit to or await the action of the courts in the proceeding, not seeking to decide which of the contesting parties is the rightful payee, but designed to divest the title of a rightful claimant for the benefit of the creditors. In such a case the state courts have no authority to interfere with or control, directly or indirectly, the action of executive officers of the national government. Under the act of July 19, 1876, executive officers of the United States are required to pay contractors by the delivery of certain government bonds. A duty is thus imposed exclusively executive in character, which cannot be defeated by judicial action." This decision was announced last month, but the bonds were not delivered to Safford & Co., because they had not presented to the treasury a proper receipt, and because the paving commissioner, under whose authority it was done, has not made a formal order directing the payment of the reserve. This week Safford & Co. filed a proper receipt. Thereupon the Comptroller informed Treasurer Gilfillan to-day that, upon the presentation of the order of the paving committee, the bonds should be delivered to the Boston firm. The order will probably be offered this week, and the bonds be delivered to Safford & Coon Monday next at the Boston sub-treasury. Out of the accumulated interest two small claims against the firm will be paid first.—*Boston Herald.*

THE DAYLIGHT OF AN ARCTIC WINTER.

Lieut. Schwatka, since his recent return from a successful expedition in search of the remains of Sir John Franklin's ill-fated company, combats the prevalent opinion that the arctic winter, especially in the higher latitudes, is a period of dreary darkness. In latitude 83° 20′ 20″ north, the highest point ever reached by man, there are four hours and 42 minutes of twilight on December 22, the shortest day in the year, in the northern hemisphere. In latitude 82° 27′ north, the highest point where white men have wintered, there are six hours and two minutes in the shortest day; and latitude 84° 32′ north, 172 geographical miles nearer the north pole than Markham reached and 328 geographical miles from that point, must yet be attained before the true Plutonic zone, or that one in which there is no twilight whatsoever, even upon the shortest day of the year, can be said to have been entered by man. Of course, about the beginning and ending of this twilight, it is very feeble and easily extinguished by even the slightest mists, but nevertheless exists, and is quite appreciable on clear cold days, or nights, properly speaking. The north pole itself is only shrouded in perfect blackness from November 13 to January 29, a period of 77 days. Supposing that the sun has set (supposing a circumpolar sea or body of water unlimited to vision) on September 24, not to rise until March 18, for that particular point, giving a period of about 50 days of uniformly varying twilight, the pole has about 188 days of continuous daylight, 100 days of varying twilight, and 77 of perfectly inky darkness (save when the moon has a northern declination) in the period of a typical year. During the period of a little over four days, the sun shines continuously on both the north and south poles at the same time, owing to refraction parallax, semi-diameter, and dip of the horizon.

THE PROTECTIVE RANGE OF A LIGHTNING ROD.

Mr. W. H. Preece has done a practical service in determining with some approach to accuracy the amount of space protected by any efficient lightning rod. Our notions on this point have hitherto been somewhat hazy and uncertain; but if Mr. Preece's conclusion is to be relied on, a lightning rod protects a conic space whose height is the length of the rod, the base being a circle having its radius equal to the height of the rod. Mr. Preece has for many years given his attention to this important subject, and in all his experience of lightning rods, good, bad, or indifferent, and the destructive effects of lightning discharges, he has, it appears, found no case where damage was inflicted within this conical space when the building was properly protected. Many cases have occurred wherein the pinnacles of the same tower of a church have been struck when one pinnacle had a rod attached; but these pinnacles can be shown to have stood without the limits of the safety cone. To protect such turrets it is therefore necessary to run a rod up every turret. It is also evident from Mr. Preece's theorem that each chimney stack and prominent point on a building should have its own rod or discharging point unless it comes within the charmed area, and that the higher the rod the greater its protective range.

AN ELECTRIC WATCH.

A watchman at Copenhagen, of the name of Sonderberg, is reported to have made a watch which requires no winding up, inasmuch as it performs that work itself by means of an electric current. An electric magnet fixed inside the watch keeps the spring perpetually in a state of tension. All that is required to keep the watch going is to preserve the battery in proper working order, for which purpose one or two inspections in a twelvemonth are said to be sufficient.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

The Blake Pump Company, Boston, is building a 1,500,000 gallon pumping engine for the City of Mobile.

The Water-works Board of Zanesville threaten to resign in a body if the City Councils persist in managing the works.

The Holly Manufacturing Company, of Lockport, N. Y., has recently completed two upright, compound, condensing pumping engines, for the city of Evansville, Indiana, of 4,000,000 gallons each, daily capacity, and they were last week tested by Mr. H. F. Gaskill, Superintendent of the Holly Company's Manufactory, on the part of the company, and Mr. John W. Hill, Mechanical Engineer, Cincinnati, on the part of the city. The result showed an average duty of both engines of over 84,000,000 foot-pounds.

Mr. C. E. Gray, of St. Louis, is canvassing the possibilities of St. Charles, Mo., on the subject of a public water supply. Mr. Gray asks no guarantee other than the exclusive right of way for twenty years, and he promises within twelve months to have his arrangements completed for furnishing to consumers in all parts of the city, not only water, but also steam for heating and motive purposes. He agrees, likewise, to erect thirty fire-plugs for the use of the city at annual rental of $100 each, but makes no stipulation on that account in the contract which he proposes to make with the city.

The American Construction Company, of New York, have contracted with the city of Council Bluffs, Iowa, for 22 miles of pipe, from 16 to 4 inches in diameter; two 3,000,000 gallons settling reservoirs, one 1,000,000 gallons distributing reservoir, 200 double-nozzle fire hydrants, two pumping engines, each capable of raising 2,000,000 gallons per day. The water will be taken from the Missouri River, through 4,000 feet of 30-inch brick conduit, to the pump well, where it will be lifted into the settling or subsiding reservoirs, and from these reservoirs it will be forced into the distributing reservoir. H. P. M. Birkinbine, 152 South Fourth street, Philadelphia, is Chief Engineer of the company.

ALBANY, Feb. 10.—An important bill was presented this morning in the House, which provides for the incorporation of the New York Water Company, with a capital of $15,000,000. The principal object of the company is understood to bring water directly into New York City from Lake George. The principal incorporators mentioned are ex-Mayor Ely, Deputy-Comptroller Storrs, A. V. Stout, John R. Adams, R. N. Hawkesmith, Minfield S. McDougall, William M. Laman, Osborne McDaniel, A. T. Post, Nicholas E. Paine, W. L. Earle and A. Palmer. Mr. Andrews has introduced a bill which compels all contractors on public buildings to employ stone cutters who reside in the localities where such work is going on.

Referring to the peculiar "cucumber taste" of the Cochituate water in Boston, as noted in ENGINEERING NEWS, page 39, *ante*, Mr. Collingwood, of the New York and Brooklyn Bridge, has informed us that he has noticed a peculiar taste to the water in Elizabeth, N. J., at various times. It occured immediately after seasons of drought, tasted like tannin, and his idea was that is was from the soaking or steeping of leaves, the water from the wooded parts of the country running over the frozen ground to the water courses, and thus remaining unfiltered as it reached the reservoirs. Mr. Collingwood suggests that the Boston Water Department note the years in which the "cucumber taste" was observable, and thus test if there is anything of value in his theory.

The Staten Island Water Supply Company will commence work as soon as the weather will permit. Mr. Lockwood, the contractor, expects to have the water in the pipes by June 1 next. The company has made a contract with the Knowles' Pumping Works for a compound condensing pumping engine, which it is expected will be ready for service on, or if possible before, the first of May next. This pump will have a capacity of one million gallons of water per diem. The pipes and casting are to be furnished by the Warren Foundry, with which a contract has been executed for the supply of twelve hundred tons of cast-iron pipe and casting. By the terms of the contract the delivery of these goods will be begun on the 15th of next month, and will be completed before the first of May. The hydrants, valves, water-gates, etc., are already ordered, and will be delivered with the pipes, etc. The supply is to be taken from Bodine's Pond, which, in the engineer's opinion, is capable of furnishing one million gallons per day. The distributing reservoir will be situated on Third avenue, New Brighton (Fort Hill), almost directly opposite where stands the late residence of Mr. H. L. Horton, ex-President of the Village of New Brighton.

Water Collector G. B. Seaman sent the following report to the Board of Public Works yesterday:

OFFICE OF THE WATER DEPARTMENT,
Jan. 25, 1881.

To the Honorable, the Board of Public Works:

GENTLEMEN: I herewith submit the annual statement of the water department of the city of Milwaukee for the year ending Dec. 31, 1880,

Respectfully,
G. B. SEAMAN, Collector.

In this connection I wish to call attention to the constant and excessive waste of water by consumers in this city. It is an unmitigated evil, which is rapidly growing more formidable and perplexing, as the service is extended, notwithstanding the constant efforts of this office to limit such waste.

The wise provisions made at the establishment of the

works, then calculated to be sufficient to supply the city for many years to come, are now found to be quite inadequate, and greater pumping capacity has been provided for during the current year. The waste of water more than keeps pace with the necessary consumption.

Since my accession to the office I have endeavored to use the limited authority vested in me in an earnest effort to stop the waste, and although our records show the application of a remedy in hundreds of cases during the year 1880, the evil seems to have sensibly increased. The trouble lies in our system, which the majority of our water-tax payers stigmatize as unjust—an opinion which many derive particular pleasure in ventilating at each recurring payment of a water rate. This injustice is illustrated by the opportunity, which is too often indulged in, of one consumer, with a small family, using and wasting as much water as half a dozen families of a similar size, which pay into the public treasury six times as much water tax. The careful man pays for the criminal waste of his improvident neighbor.

There was pumped into the reservoir during the year 1879, 3,387,000,000 gallons of water. For that amount the city should have realized a revenue, at one cent per hundred gallons, of $338,700, instead of the paltry sum it did receive, to wit: $121,555. The difference between these amounts, or $217,145 per year, or $678.69 per day, very nearly represents the loss or waste. It adds nearly that sum to the annual tax roll.

There is but one way to stop this enormous and unnecessary waste, and that is to require the use of meters at all places where they can be safely used.

Inspection of the following table will show:

First. The city of Providence with a population about equal to Milwaukee, and with 585 more service connections, uses but 2,500,800 gallons per day, while Milwaukee uses 10,603,867 gallons.

Second. Providence uses 25 gallons per day for each inhabitant; Milwaukee uses 124 gallons per day for each person.

Third. Providence consumes each day for each service 337 gallons; Milwaukee 1,551 gallons.

Fourth. Providence derives a revenue of $900,039 for 2,500,000 gallons, while Milwaukee gets $131,555 for 10,603,867 gallons.

Fifth. Providence receives $919 per million gallons; Milwaukee $31.

Sixth. Providence consumes 17,367 gallons per mile of pipe; Milwaukee 123,300 gallons.

I desire to call attention to the following table, compiled from official sources, and presumed to be correct, which demonstrates the efficiency of the meter system:

CITY.	Population.	Daily consumpcion—gallons.	Daily consumption per head—gallons.	Number of services.	Consumption per service—gallons.	Total income for use of water.	Receipts per million gallons consumed.	Receipts per mile of pipe.	Number of meters.	Consumption per mile of pipe—gallons.
Providence, 1877	100,000	2,500,800	25	7,420	337	$900,039	$919	$1,389	3,203	17,367
Cleveland, 1877	136,000	11,728,920	86	7,760	1,511	131,555	54	1,415	2,946	71,546
Detroit, 1877	110,000	11,345,130	103	7,754	1,463	131,555	54	1,084	0	59,606
Buffalo, 1877	135,000	10,601,300	78	6,325	1,676	131,555	54	2,094	0	125,040
Milwaukee, 1879	116,000	10,603,867	124	6,835	1,551	131,555	31	1,413	101	123,300

The reason for this vast and important difference in results is this: Providence had in use 3,203 meters; Milwaukee was content with 101.

With us this great consumption of water is not due to growth in population nor leakage in the public mains. It arises principally from allowing water in yard hydrants, house faucets, water closets and urinals to run without any use being made of it.

A quarter-inch faucet will pass, at our average pressure, about 10,000 gallons in twenty-four hours, and it may be safely stated that an average of 25 faucets in each ward of this city are allowed to flow continually without use, thus causing a daily waste from this source of 3,250,000 gallons, worth to the tax payers of the city $325 in coal, labor and repairs.

Families which use water only for ordinary domestic purposes consume about ten gallons per capita per day.

The meter rates in St. Louis and Chicago are as follows:

	St. Louis. Cents.	Chicago. Cents.
Daily average 500 gals. or less per 1,000 gals.	35	60
Daily average 500 to 1,000 gals.	33	57
Daily average 1,000 to 2,000 gals.	31	53
Daily average 2,000 to 3,000 gals.	29	50
Daily average 3,000 to 4,000 gals.	27	47
Daily average 4,000 to 5,000 gals.	25	43
Daily average 5,000 to 6,000 gals.	23	40
Daily average 6,000 to 7,000 gals.	21	37
Daily average 7,000 to 8,000 gals.	19	33
Daily average 8,000 to 10,000 gals.	17	30
Over 10,000 gals.	15	..

I take it the city of Milwaukee does not desire to make money out of its citizens, but simply to furnish them pure and wholesome water at reasonable rates.

It costs the city about five cents per 1,000 gallons to pump the water, and I would therefore respectfully suggest the adoption of a schedule of water-rates which will furnish water to manufacturers and very large consumers at a trifle more than cost, and graduate the price from that up to a reasonable charge on the smallest consumer. In my opinion the following is such a scale of rates, which, although lower than that of any other city, is sufficiently high to cover expenses, and I think will be acceptable to consumers:

No bill to be made out for less than one dollar.

Per 1,000 gallons, for a daily average of

	Cents.
100 gallons or less	40
100 gallons to 200	35
2 0 gallons to 300	25
300 gallons to 400	20
400 gallons to 500	15
500 gallons to 1,000	10
1,000 gallons to 2,000	09
2,000 gallons to 3,000	08
3,000 gallons to 4,0 0	07
4,000 gallons to 5,000	06
Over 5,000 gallons	05

These rates, if accepted by consumers, and measured by meter, would decrease their water bills from 30 to 50 per cent., and if generally accepted would greatly lessen the waste, and decrease the necessity, for the present enormous pumpage.

STREETS, DRAINAGE, ETC.

BOSTON SEWERS.—The annual report of the superintendent of sewers for 1880 was presented, and ordered to be placed on file. From it it appears that the amount expended during the year was $125,705.39, for laying sewers, building catch basins and for miscellaneous expenses as follows: City proper, 5,160 feet of sewers, $11,397.94; city proper, 55 catch basins, etc., $8,558.40; South Boston, 833 feet of sewers, $1,127 30; South Boston, seven catch basins, etc., $1110.94; East Boston, 1,679 feet of sewers, $4,501.54; East Boston, 16 catch basins, etc., $2,206.42; Charlestown, 358 feet of sewers, $920.25; Charlestown, 12 catch basins, etc., $1,559.87; Dorchester, 8,374 feet of sewers, $15,067.20; Dorchester, 26 catch basins, etc., $2,067.20; Roxbury, 5,077 feet of sewers, $13,071.31; Roxbury, 18 catch basins, etc., $2,811.46; West Roxbury, 2,736 feet of sewers, $5,872.89; West Roxbury, 15 catch basins, etc., $1,747.02; totals, 24,217 feet (4½ miles) of sewers, costing $51,958.43; 149 catch basins, etc., $21,041.31; miscellaneous expenses, $52,705.65; grand total, $125,705.39. The whole length of sewers in the city is now about 191¾ miles. Assessments have been levied by the board of aldermen, and bills sent to the collector, to the amount of $37,547.87. The collector has received during the year, on account of the department, $23,703.95. During the year 1,392 permits have been given to construct or repair house connections, and 1,066 loads, equal to about 2,666 cubic yards, of sewage matter have been removed from the sewers. Annexed to the report is the customary table of rainfall, and, in connection therewith, a table showing the maximum heights of the water in the tide locked sewers at the south end during the heaviest storms of the year.

BRIDGES.

The new bridge across the Niagara River, at Tonawanda, for the Canada Southern Railroad, will be begun in spring.

The bridges on all the small streams in the vicinity of Lawrence, Kansas, have been carried away by a freshet of the 7th inst.

The immense bridge built by the International Railroad across the Colorado River, at Austin, will be completed, and trains running over it by the 1st of March.

The third span of the new bridge of the Lake Erie & Western Railroad over the Wabash River at Lafayette, Ind., has been completed. It will cost in the neighborhood of $250,000.

The Cleveland Bridge and Car Works are turning out 55 cars weekly, on a contract for 500 cars for the Tuscarawas Valley Railroad. When this contract is filled they begin on one of the C., C. & I. R. for 500 cars.

The Chicago, Rock Island & Pacific Railroad has 2,556 bridges of all classes, aggregating 35 miles in length. The road has 232 stations, with their depots, 36 round-houses, 95 water-stations, and maintains 40 stationary engines and 55 mill-powers to supply stations with water.

The contract for the wrought-iron bridge over the canal at Jefferson street, Schenectady, N. Y., has been awarded to Geo. C. Power, of Hudson, for $28.53 per lineal foot. The other bids were from the Hilton Bridge Company, of Albany, $29.90, and M. A. Nash, Fort Edward, $30.48.

The Canal Board has decided to advertise for bids for improving the Champlain Canal and the Glens Feeder, and for building wrought-iron bridges—one over the Erie Canal, near Becker's, and two over the Champlain, one at Bemis Heights, and the other at Fort Anne. Several wooden bridges will also be built over the Champlain.

DETROIT, Mich., Feb. 6.—The contract for the iron bridge for the Northern Pacific Railroad over the Missouri River at Bismarck, D. T. (designed by Mr. Geo. S. Morison), to be begun at once, has been let to the Detroit Bridge and Iron Works of this city. The cost of the bridge will be $700,000, and it will be 1,500 feet long. Three of the spans will be 400 feet long each. The bridge is to be completed in the spring of 1882.

The Philadelphia Bridge Works, at Pottstown, have received contracts for building an iron bridge of six spans, 100 feet in length, and a draw span of 200 feet, for the New Orleans & Pacific Railroad Company; also for a bridge of three spans, of 150 feet in length each, for the Texas Pacific Railroad. Another contract has been received for making 350 tons of iron for the Pennsylvania Railroad Company's elevated branch. The firm now employs 208 men, and runs night and day.

CINCINNATI, Feb. 10.—Telegrams report the destruction by high water as follows: The pier of the railroad bridge at Bainbridge, Ohio, was washed away. The old bridge put up in 1817, at the Falls of the Hocking, near Logan, Ohio, was swept away. The bridge of the Springfield Southern Railway, at Greenfield, Ohio, was damaged. The new bridge at Landerburgh Ford, near Gambier, Ohio, has commenced to give way, and the bridge of the Cincinnati, Hamilton & Dayton Railroad at Lima, O., is in danger. Last night Clark & Sharp's mill, near Alamo, Ind., on Sugar Creek, was swept away. Loss, $6,000. Four mill dams on Sugar Creek were destroyed, and a new iron bridge across Walnut Fork, on Fredericksburg pike, near Crawfordsville, Ind., was destroyed. Loss, $7,000. Part of the iron bridge over the same stream was washed away. At Sullivan, Ind., yesterday, the 100 feet span of the railroad bridge over the Wabash, on the Illinois side, went down under the pressure of the flood of water and ice. Ice is piled twenty feet high against the other spans, and they are expected to go. The loss is estimated at $175,000. At Marion, Ind., the railroad bridge over the Mississinewa River was swept away. At Spencer, Ind., two spans of the State House bridge were carried away.

RAILROADS.

The Delphos & Burlington is the longest narrow-gauge railroad in the world.(?)

It is reported that the engineer corps to survey the Morgan road from Cuero to Austin, will take the field next month.

The International construction train is five miles out from San Antonio, and the whistle of the engine is plainly heard.

The Chesapeake & Ohio Railroad lacks only 75 miles of a trunk line. The connecting link will be finished by the 1st of June.

The International is under contract to Laredo, on the Rio Grande, and all teams that can be had are being employed on the extension.

WILMINGTON, Del., Feb. 10.—The bill to give the Baltimore & Ohio Railroad the right to run its new line to New York through this State by way of Wilmington passed the State Senate at Dover to-day.

The preferred stockholders of the New York, Ontario & Western are supposed to be entitled to no more rights than the common in the North River Construction Company.

The original owners of the securities of the New York, West Shore & Chicago received very little for their valuable franchise. The $1,000 bonds sold as low as $20 each last summer.

The Jeffersonville, Madison & Indianapolis management will make extensive improvements to the road-bed this summer. Forty miles of steel rails are to be laid and 150,000 cross-ties put in.

At least 20,000 men are employed on the various lines of railroad now building in Mexico. A thousand men are at once to be put to work on the new road between San Luis Potosi and Tampico.

The Utah & Northern Railroad is now the longest narrow-gauge in the country.(?) Its rolling stock for this year will be not less than seven hundred and twenty cars and thirty-six locomotives.

William H. Vanderbilt has purchased Manhattan market property, in New York City, for railroad purposes, paying $375,000. He also purchased land in front extending to North River.

RICHMOND, Va., Feb. 10.—The Atlantic, Mississippi & Ohio Railroad was sold to-day at public auction, Clarence H. Clark, of Philadelphia, becoming the purchaser for himself and associates for $8,605,000.

A narrow-gauge railroad is to be built from Bethlehem station on the Boston, Concord & Montreal Railroad, to the Maplewood house. Several deep cuts will have to be made, and the grade will be some 225 feet to the mile.

The Circuit Court at Des Moines, Ia., in the case of the Chicago & Rock Island Railroad, has declared that a lease of a branch line giving a contract for 999 years is void—a decision of importance to railroad companies in Iowa.

Atlantic & Great Western preferred stock is selling 1 per cent. lower than the common, as was the case in a similar speculation a year ago. There is more specu-

lation in the common, and this causes it to sell higher than the preferred.

The forthcoming report of the Railroad Commissioners will contain an excellent railroad map of Ohio, showing all the new lines and many roads now in process of construction. It will be duly appreciated, as there is now no reliable railroad map of the State.

The entire eastern part of Texas is a vast pinery several hundred miles long and two hundred miles wide, and the remainder of the State a vast prairie, interspersed with belts of hard wood timber. In this division into pine timber and prairie consists the grandest resources of the State.

Regarding the new roads to Chicago and St. Louis, it may be well to state that labor and material are both scarce and high. It takes considerably more time now to complete a road than in 1878-9. The ordinary calculations are therefore not to be relied on when new schemes are floated.

The St. Gothard Tunnel furnishes another striking example of accurate surveying. Although the entire length of the tunnel is nine and a quarter miles the two galleries were bored with such precision that they met with a difference of only four inches in level and a lateral deviation of less than eight inches.

The track of the Texas & Pacific Railroad is now laid to Tebo, in Taylor County, Tex., 205 miles west of Dallas, and is being continued west at the rate of one mile per day. The elevation is 2,000 feet above tide-water at Galveston. Will reach the Colorado River April 1. Mr. W. M. Johnson is engineer in charge of track, with headquarters at Dallas.

A Winona (Minn.) dispatch says: "The line of the Chicago & Northwestern Railroad has been located for a distance of fifty miles beyond the Missouri. As yet no contract has been made for construction. The route, as located, is up the Bad River to the North Fork of the Cheyenne, crossing at a point four miles below the junction of the North and South Forks. It then follows the North Branch westward."

The base of the Mont Cenis Tunnel at the French entrance shows such ominous signs of sinking that the Paris-Lyons Mediterranean Railway Company intend to have another entrance to the tunnel bored, which is to be situated at about one kilometer's distance from the present entrance, and is to reach the old tunnel at a spot about 600 meters from its mouth. The work has already been commenced.

The new railroad from Keokuk to Mt. Pleasant and N. W. reached Mt. Pleasant on the 29th ult. There is still considerable work to be done on the road before regular trains can be run, but the railroad company are doing all in their power to push things. They have been working Sundays and all during the entire winter, cold as it has been.

The Union Pacific people are busy pushing on the work of the broad-gauge road from Fort Collins westward. The idea is to build a broad-gauge road with all possible dispatch, beginning at Denver and extending in a direct line through the coal fields of Boulder county to Longmont, and from Fort Collins up the Cache la Poudre to the North Park, then into Middle Park via Muddy Tapping, the new mining camp in Lead Mountain.

The Delaware, Lackawanna & Western Railroad has replaced three wooden bridges with iron plate girder bridges, of 26, 30 and 35 ft. spans, and are just finishing the erection of a bridge over Grand River, consisting of two 165 ft. spans, to replace a wooden structure. The iron work is all made by the Detroit Bridge and Iron Works. The company have also built one arch culvert of 12 ft. span, 70 ft. long, and several small ones; stone work done by J. S. Farr & Co., of Grand Rapids. They have also built a branch five miles long during the past year.

A railroad company was organized at Indianapolis, Feb. 3, under the name of the Peoria & Pekin Railroad Company. The company proposes to operate upon a system similar to that of the Chicago & Western Railroad Company, do all the business between Pekin and Peoria, and the switching at both points for the following roads: The Indiana, Bloomington & Western, the Peoria, Decatur & Evansville, the Peoria, Pekin & Jackson and the Wabash. The four lines named are parties to the contract, and arrangements will be made soon by which the Illinois Midland and the C., P. & S. W. will co-operate with them.

A Wall street broker says: "We will now have a Southern trunk line which will make Norfolk, Va., of some importance as a shipping port. The past due bonds of the Atlantic, Mississippi & Ohio Railroad are to be paid by a syndicate which has raised $3,000,000, and it will not be sold. The towns along the line of the road that held its stock have surrendered half to the syndicate. By connections with the Selma, Rome & Dayton road and the Vicksburg & Meridian road, a through connection is secured from Norfolk, in Virginia, to Shreveport, La. At this point it connects with the Texas & Pacific and with the Vicksburg, Shreveport & Pacific; so you have really a new trunk line under one management. The leaders in the syndicate are R. T. Wilson and Jay Gould."

The English mail steamer from Vera Cruz brings advices from the city of Mexico to Jan. 30. The Sullivan Company have purchased the Zacatecas & Guadalupe Railroad and purpose to make it part of their great trunk interoceanic line. The Simon Company have begun work on the road between Queretaro and Celaya. Many engineers have arrived and a large quantity of material has been landed for the American companies. It is reported that work on the Tehuantepec Railroad has been suspended, and will so remain until the fate of Captain Eads' project in the United States is known. The Merida & Progreso Railroad will be completed in a few months.

Experts have arrived to test the ores in the silver mines for the company which Mr. William Denton has organized in New York. The mines are situated in the State of Michoacan.

Mr. C. W. Sturtevant, Commissioner of the Board of Trade of San Francisco, had arrived at Mazatlan to study Mexican commerce.

Mr. Edward Learned, President of the Tehuantepec Railroad, writes, Feb 7, that there has been no suspension of work on that road, nor will there be any. On the contrary, the Tehuantepec Inter-Ocean Railroad Company is pushing forward its work with the utmost vigor, and the recent loan placed on the market assures the early completion of the road.

Wm. J. McAlpine, Consulting Engineer, with a party of assistants, left New York on the 7th, via San Francisco, to commence work on the Pacific side.

RAILROAD WAGES THIRTY YEARS AGO.—A New Hampshire paper gives in a recent issue a summary of the contents of the annual report of the Concord Railroad for 1851. The report filled 81 pages, and contained a list of all the tools owned by the road, of all the furniture in the stations on its line, and every other article, however small, that went to make up its assets; and, besides these, a complete roll of all the employés of the road, from the superintendent down to the wood-sawyers, with the wages paid to each. Isaac Spalding was president, with a salary of $1,000; the Hon. N. G. Upham was superintendent, and got for his services $2,000 a year; the chief clerk got $800, and the assistant $340, the latter being Henry McFarland, now treasurer of the Union Pacific, with a salary of $5,000; George Clough was a passenger conductor and got $50 a month, which was the pay of the station agent at Nashua; engineers on passenger trains had $2.25 per day, and those on freight trains $2; brakemen and firemen $1.25, and wood-sawyers and section men $1; the ticket agents at Concord and Manchester had $800 a year, and ex-Gov. James A. Weston, who was the road engineer, $1,000; the wood shop at Concord was in charge of the Hon. John Kimball, who had $3.19½ per day, and one of his workmen was his brother, Benjamin A., who got but $6 a week. These last mentioned are now two of the wealthiest men in Concord, and one is a director of the road. At that time the road did but a third as much business as now, but it paid 10 per cent. dividends.

MISSOURI, ARKANSAS & SOUTHERN.—The St. Louis *Republican* has obtained from James Dun, Chief Engineer of the St. Louis & San Francisco Railroad, some interesting information regarding the new extension of his road, projected and in course of construction from Pierce City to Dallas, Texas. The line is to pass through the territory of the Choctaw Nation; the Choctaws are willing to grant such right of way. The advantages of the proposed line to Missouri is not a question of dispute. It requires no money appropriations or subsidy of lands. The projected line will strike the corner of the Choctaw Nation at Fort Smith and follow up the Poteau Creek Valley, and then go down the Kiminshi Valley to the Red River, passing through and near Spencer Academy and Scullyville, in the Choctaw Territory. The people of the Nation are intelligent, and many well educated. They do not appear to be adverse to the progress of civilization, and do not object to the construction of railroads in their country. From the Red River the road will pass into Texas, and go through Paris to Dallas, where it will connect with the Houston & Texas Central Railway system. The road is already constructed and in operation from Plymouth, near Pierce City, to Seligman, on the Missouri and Arkansas border, where the trains connect with daily stages for Eureka Springs, Bentonville, Fayetteville and Fort Smith, Ark. The road is already under contract south of Fayetteville, Ark., and surveys are made, or are being made, to the Arkansas River at Van Buren. Mr. Dun has four parties in the field, three of them making preliminary surveys and one locating the track south of Boston Mountains. Where the road crosses the latter mountains, the elevation is 1,900 feet above the sea. A tunnel, 1,400 feet in length, will be constructed through the Boston range at Woolum's Gap, which will cost about $70,000, and, including the tunnel with about six miles of heavy grade on the south side of the mountain, the estimated cost is $75,000 per mile. Starting from Pierce City, the length of the road will be 135 miles to Fort Smith, and from Fort Smith through the Indian Territory to Paris, Tex., the distance will be 135 miles, making it the shortest route between St. Louis and Dallas.

RIVERS AND HARBORS.

The River and Harbor bill was defeated.

Dam No. 1, Monongahela River, has broken away in a gap of 150 feet wide, and it is feared the whole dam will go. The report states that it will cost $50,000 to repair damage.

The new lighthouse at Belleville, Ont., is to be built on a pier in water six feet deep, on the easterly edge of the western shoal at the entrance to the harbor, about 500 feet S. W. from the extremity of the present Grand Junction Railway Company's wharf.

The contract for building the new Greenville (Mass.) dam has been awarded to Mr. William Burdick, of Norwich, Conn. He will put about 300 men at work on it, and push it to completion during the coming summer and fall. The dam is to be 470 feet long, and of granite, each stone to be joined by a wrought-iron anchor to the one next to it, and will cost about $60,000.

Vicksburg, Miss., is making a strenuous effort to have Congress appropriate money to restore the river to its former channel. J. A. Ockerson, U. S. Assistant Engineer of the Mississippi River Commission, has recently made a survey of the harbor, embracing thirty miles of the river in that vicinity, with a view to the proposed restoration of the river to the city front.

The survey of the jetties made under the direction of Captain Huer, on the 20th of January, 1881, shows that they are in fine order and are doing perfectly the services required of them. Captain Huer states that he found them in excellent condition. By law the width of the channel required is 200 feet with a depth of 26 feet. This has been maintained; soundings are frequently made to prevent the accumulation of mud, and such accumulations are quickly removed by the dredge-boat stationed there for that purpose. The central depth of the channel is 30 feet, which depth varies in width, but at no point is it narrower than twenty feet. Even with this width, it is possible for ships drawing 30 feet to pass through, if they keep in the middle of the channel. The channel is straight, and at no time have lumps of mud accumulated in it.—*N. O. Picayune.*

NEW PROJECTS.

The Columbus Electric Light Company, with a capital of $100,000 has been incorporated by John Joyce, James A. Wilcox, J. M. McCune, John Beatty, Alfred Kelley, Theodore Leonard, and Walter Morrison.

There is a project on foot to build a railroad from Covington, Ky., through Cumberland Gap, Morristown, etc., to connect with other lines, and complete an air line through to Charleston, S. C. The Western North Carolina will be completed about July 1, as there are only some 28 miles to grade. Cumberland Gap, it is thought, will have the great line of the future from the Ohio to the sea coast.

A proposition from the Central Railroad of New Jersey to connect a branch from Cleveland to Milton, N. J., and thence to New York, is under consideration. A survey has been made for this proposed route across the Alleghany Mountains, through Youngstown, midway between Oil City and Pittsburgh. The pass is said to have a grade not exceeding 56 feet to the mile. Another proposition is a connection with the Delaware, Lackawanna & Western Railroad.

William E. Dodge and others have filed articles incorporating the New York, Maderia and West Coast of Africa Steamship Campany, with a capital of $100,000, with a proviso that it can be increased to $4,000,000. Mr. Dodge stated that the company was formed to provide a steamer for carrying emigrants to Liberia, in place of the present slow-sailing vessels. The organizers of the company were those who have been interested in the colonization movement. It was thought by Gates & Porterfield, the firm which has had charge of this trade for twenty-five years, that a line of steam vessels stopping at the principal points in that direction would be profitable. The first steamer will be built without delay, and its estimated cost is $100,000.

Letters have passed between Mr. A. H. Grigg, President of the Morristown, Cumberland Gap & Ohio Railroad, and Mr. A. L. Green, looking to a revival of the old project of building a railroad from Covington, Ky., through Cumberland Gap, Morristown and French Broad Valley, to connect with other lines, and complete an air-line through to Charleston, S. C., and other points on the sea coast. In one of his letters Mr. Grigg says the Western North Carolina road will be completed by the 1st July next, thus giving Morristown direct communication south with Charleston, Wilmington and Port Royal. "Our intention is to build a road north from Morristown to Cumberland Gap, hoping to meet at that point some road that will afford us direct communication with the great cities on the Ohio and in the Northwest."

The North River Construction Co. has been organized to build and equip the New York, West Shore & Buffalo Railway, the main line of which extends from Cornwall-on-the-Hudson to a point near Athens, thence to an intersection with the New York, Ontario & Western Railway near Oneida, and thence on to Buffalo, a distance of 360 miles. The New York, West Shore & Buffalo Company was created last year by a New York State charter, with an authorized capital of $30,000,000. This company and the Ontario & Western will have joint use of a double track from Cornwall down to Weehawken. It is estimated that the road can be built to Buffalo within two years; that the maximum grades, going east, between Buffalo or Oswego and New York, will not exceed twenty-six feet per mile, and that those going west will not exceed thirty feet per mile. A meeting of the company was held a few days ago in the office of E. F. Winston, 30 Nassau street.

A meeting was held last week at the Metropolitan National Bank, New York, to discuss plans for the New York, Chicago & St. Louis Railway, which has a capital of $16,000,000, of which $13,500,000 is subscribed. Arrangements have already been made for the control of fifty-six miles of the old Wabash Canal, the canal basin to be used as a road-bed. The line from Cleveland to Chicago, which has already been surveyed, is first to be put under contract, and application has been made for an Indiana charter for the company. It has not been determined how the new line is to come into New York City, but three routes are under advisement. One runs via Oil City to Milton, and thence across New Jersey. Another plan is to use the track of the Delaware, Lackawanna & Western road, and a third is to contract with the Ontario & Western road to use that line when it is completed. Among those at the meeting were Geo. I. Seney, President of the Metropolitan Bank; G. L. Seymour, C. R. Cummings, E. H. R. Lyman, J. F. Mott, Walston H. Brown and A. M. White.